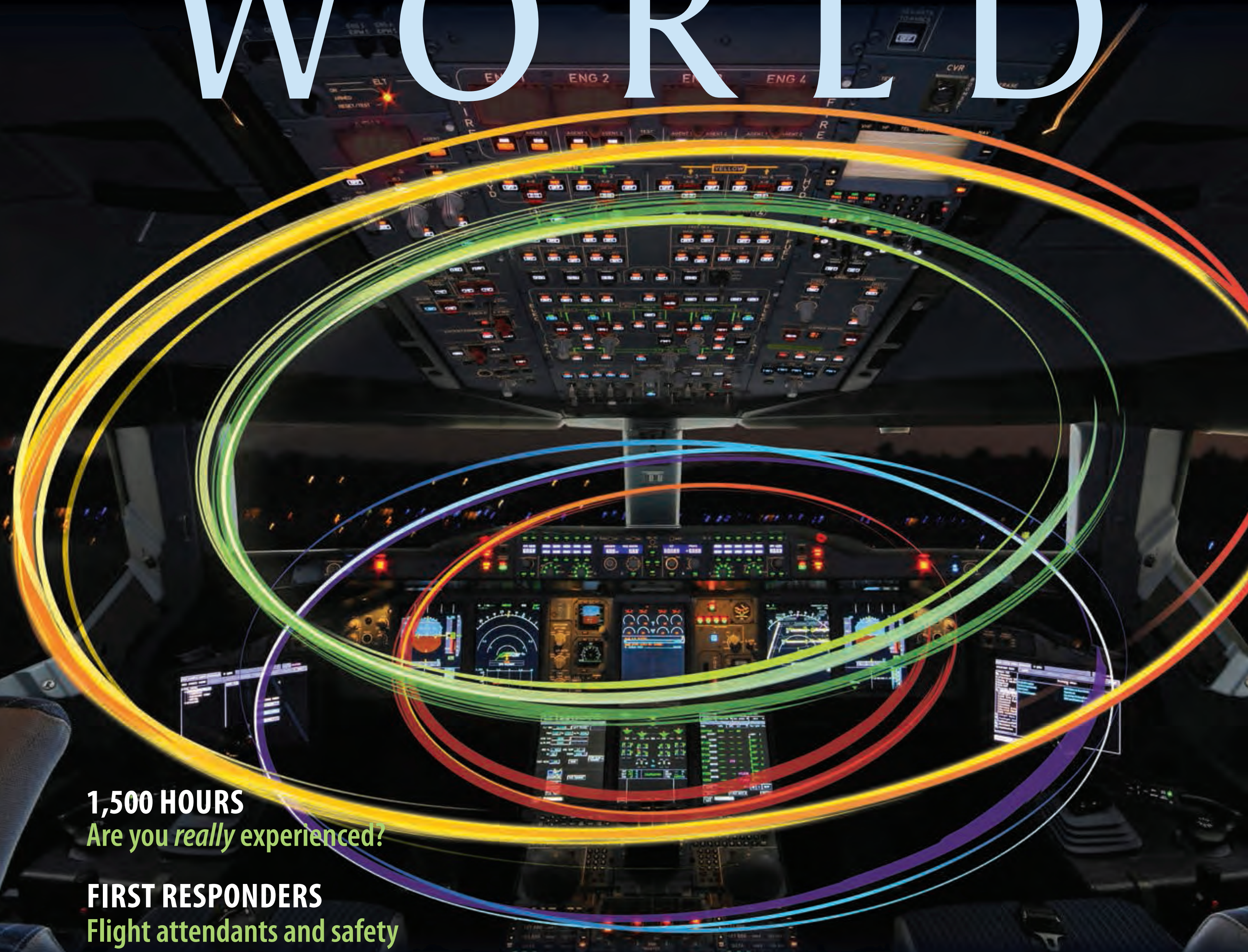
AeroSafety WORLD



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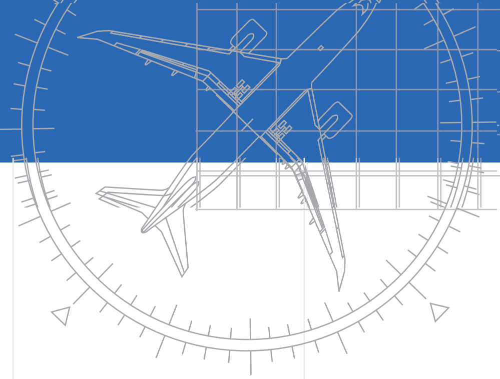

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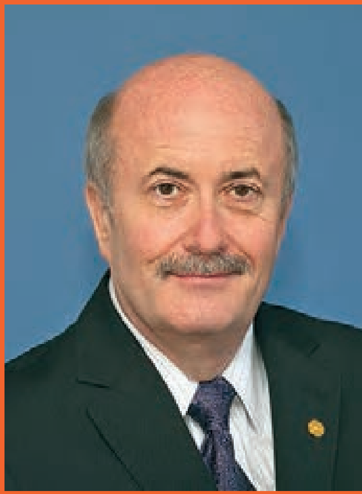


MISTAKEN Assumptions

This is a bit of a confession. I had a seat at the table when the international community debated how safety management systems (SMS) would fit into the international regulatory framework. My colleagues and I missed something really big. We all assumed that the industry would stay the same, that airlines would retain their nationalities like they had for the previous 60 years. Everything was built on the assumption that each country would have a regulator that would oversee multiple airlines, each holding a single air operator certificate (AOC) and each with its own SMS. Each SMS would be run by an accountable executive who would set safety targets and proactively manage risk. The accountable executive would report to the regulator, who would make sure the executive was doing a responsible job and ensure that the efforts of the airlines would achieve a target level of safety for that country that would satisfy the flying public. These all seemed like reasonable assumptions at the time, but they were wrong.

Let's look at reality. Airlines have found a work-around to the restrictive notion that they must have nationalities. Instead, they're forming airline groups that span borders. When an airline wants to expand its market, it needs traffic rights. It gets those traffic rights by buying or creating subsidiary airlines in other countries. A significant percentage of the world traffic is now managed by international airline groups that oversee a dozen or more AOCs in eight or 10 different countries. Just consider Qantas, Air Asia, Singapore (Tiger), Hainan Group, LAN/TAM, Copa and Air France/KLM, to name a few.

This is a great way to circumvent ownership and trade regulations that have crippled the industry. Safety could actually benefit through better centralization of data and analysis, but the underlying assumptions behind SMS and state safety programs no longer make sense.

Just imagine you are an accountable executive at a subsidiary airline. Much of the safety oversight is done by the parent airline's safety department, which has access to data from all of its subsidiaries and has access to the board of directors. But you report to a regulator in your country that expects you to run your own SMS, based on agreements between your airline and the regulatory agency. So what happens? Perhaps your regulator says you have to change a process or a target in your SMS. You coordinate with people in the group safety office a thousand miles away and they disagree. You are stuck. Or the group safety office decides to do business in a new way, and your regulator disagrees. You have a choice between getting in a fight with the guy who holds your certificate or the guy who signs your check. It is a system that is "spring-loaded to the screw-up position."

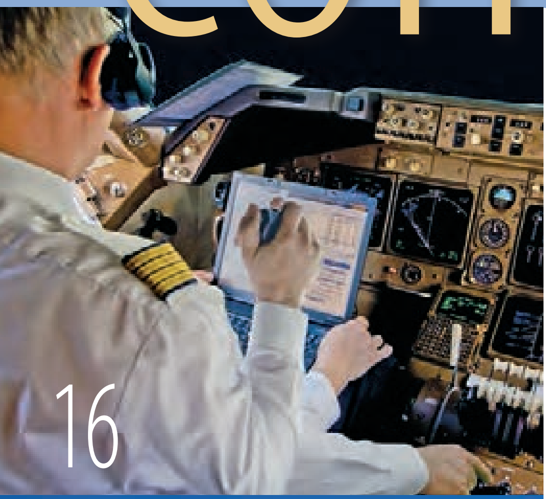
So what do we do about this mess? The Foundation is trying to start a new conversation within airlines and the international regulatory bodies. It is essential that we figure out the proper relationship between the corporate governance of multinational airline companies and the operational application of SMS. The vision we had at the end of the last century is not going to fit the industry that is emerging today. It is time to deal with it.

William R. Voss
President and CEO
Flight Safety Foundation

AeroSafety WORLD

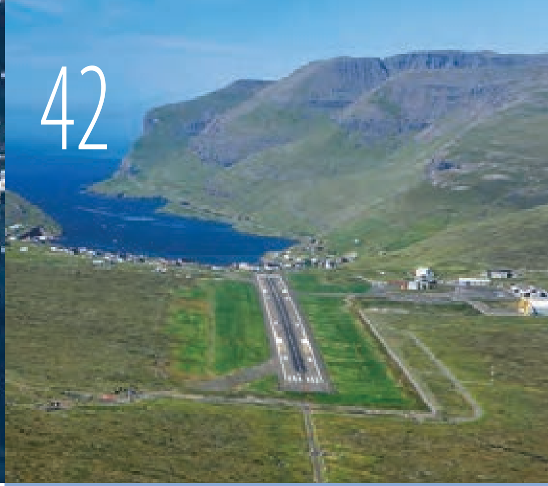
contents

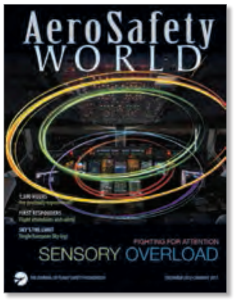
December 2012–**January** 2013
Vol 7 Issue 11



features

departments





About the Cover
Sensory overload could be a problem in emergencies.
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If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications Frank Jackman, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA or jackman@flightsafety.org.

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Serving Aviation Safety Interests for More Than 60 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,075 individuals and member organizations in 130 countries.

Member**Guide**

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LOOK BACK, Move Forward

Editorials written at this time of the year often are dedicated either to looking back at the year past or ahead at what's to come. I am writing this early in the final month of 2012, but most of you won't see it until early in 2013, so I am going to grant myself the liberty of doing both.

Looking ahead, *AeroSafety World* will strive to continue to deliver the in-depth safety information, data and analysis for which it is known. Some of the subjects we will tackle in 2013 include helicopter safety, unstable approaches and go-around decision-making, voluntary reporting systems, the integration of remotely piloted vehicles into civilian airspace, multi-crew pilot licensing, operations in remote regions and the safety implications of NextGen. Revisions to the International Civil Aviation Organization's Global Air Navigation Plan, further developments in the industry's efforts to protect safety information from misuse, and Foundation-aided safety efforts in developing countries also will be covered. As always, we welcome your comments and ideas for articles.

Flight Safety Foundation COO Kevin Hiatt has details on p. 7 about some Foundation-specific developments you can expect in 2013, but there is one I particularly want to highlight. Beginning with the February issue of *ASW*, website access to the most current issues of the magazine will be limited to Foundation members for three months following publication. For example, once the February issue is published, it will be posted to the Foundation website, but most of the issue's content will be accessible only by members or the employees of member organizations until early May, when it will be made available on a publicly accessible area on our website. Print distribution of the magazine, which already is limited to individual members and member organizations, will not change, although you likely will see each issue of the magazine earlier in the month (see below). Archived issues of the magazine will continue to be publicly available.

In 2013, we again will publish 11 issues of *ASW*, with a combined December 2013–January 2014 issue. You should, however, see the magazine earlier each month than in years past. Beginning with the February 2013 issue, we are changing the *ASW* publication cycle. Copies of the magazine will be mailed within the first few days of the issue month. So, your February issue should be on its way to you early in the month.

Looking back, 2012 has been a busy year. In addition to our usual array of successful seminars and safety projects, we have made some changes internally to make *ASW* and the Foundation run more efficiently and to better serve you, our members and the cause of aviation safety. For example, if you haven't already taken a look, please check out the redesigned *ASW* landing page on the Foundation's website. The changes made several weeks ago make the articles and information more accessible and easier to read.

On a personal note, I joined Flight Safety Foundation in April to succeed the retiring J.A. Donoghue and, as expected, Jay has proved to be a tough act to follow. The learning curve has been steep, but the subject matter is fascinating and my education has been hastened by numerous people within the Foundation and across the industry. Please accept my heartfelt thanks. Of course, I have had a great deal of help from the talented and patient *AeroSafety World* editorial and production staff, and for that, I want to say thank you. In addition, I want to thank the writers and photographers on whose talent and effort much of *ASW*'s reputation is built. With your help, we can continue to make a difference.

Happy New Year.

Frank Jackman
Editor-in-Chief
AeroSafety World

JAN. 8–17 ➤ SMS Training Certificate Course. U.S. Transportation Safety Institute. Oklahoma City, Oklahoma, U.S. D. Smith, <d.smith@dot.gov>, <www.tsi.dot.gov>, +1 405.954.2913. (Also MAY 14–23, JULY 30–AUG. 8.)

JAN. 9–11 ➤ Risk Management Conference. Airports Council International–North America. Las Vegas, Nevada, U.S. <meetings@aci-na.org>, <www.aci-na.org/event/2406>, +1 202.293.8500.

JAN. 13–15 ➤ SMS/QA Genesis Symposium. DTI Training Consortium. Orlando, Florida, U.S. <www.dtiatlanta.com/Events.html#>, +1 866.870.5490.

JAN. 14–16 ➤ Safety Management System. Curt Lewis & Associates. Dallas. Masood Karim, <masood@curt-lewis.com>, +1 425.949.2120.

JAN. 14–FEB. 22 ➤ Aircraft Accident Investigation. Cranfield University. Cranfield, Bedfordshire, England. <chloe.doyle@cranfield.ac.uk>, <www.cranfield.ac.uk/soe/shortcourses/training/aircraft-accident-investigation.html>, +44 (0)1234 758552. (Also MAY 13–JUNE 21.)

JAN. 16–17 ➤ Non-Destructive Testing Audit Oversight Course. CAA International. London Gatwick Airport. <training@caainternational.com>, <www.caainternational.com>, +44 (0)1293 768700.

JAN. 17–18 ➤ Advance Safety Management System. Curt Lewis & Associates. Dallas. Masood Karim, <masood@curt-lewis.com>, +1 425.949.2120. (Also FEB. 28–MARCH 1.)

JAN. 22–24 ➤ System Safety Specialist. Curt Lewis & Associates. Seattle. Masood Karim, <masood@curt-lewis.com>, +1 425.949.2120.

JAN. 23–25 ➤ Airport Wildlife Hazard Management Workshop. Embry-Riddle Aeronautical University and Burbank Bob Hope Airport. Burbank, California, U.S. <training@erau.edu>, <bit.ly/OUYFlq>, +1 386.226.7694.

JAN. 28–FEB. 1 ➤ SMS Principles. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <maimail@mitre.org>, <mai.mitrecaasd.org/sms_course/sms_principles.cfm>, +1 703.983.5617. (Also MARCH 11–15, MAY 13–17, JULY 15–19.)

JAN. 28–FEB. 6 ➤ SMS Theory and Application. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <maimail@mitre.org>, <mai.mitrecaasd.org/sms_course/sms_application.cfm>, +1 703.983.5617. (Also MARCH 11–20, MAY 13–22, JULY 15–24.)

FEB. 4–5 ➤ Human Factors in Aviation/CRM. Vortex Training Seminars. Denver. Stephanie Brewer, <sbrewer@vortexfsm.com>, <www.vortexfsm.com/seminars>, +1 303.800.5526.

FEB. 4–6 ➤ Safety Management Systems and Flight Data Monitoring. Vortex Training Seminars. Denver. Stephanie Brewer, <sbrewer@vortexfsm.com>, <www.vortexfsm.com/seminars>, +1 303.800.5526.

FEB. 4–8 ➤ Accident Investigation. ScandiAvia. Stockholm. <morten@scandiavia.net>, <bit.ly/WsvNcL> , +47 91184182.

FEB. 11–15 ➤ Human Factors in Aviation/CRM Instructor Training. Vortex Training Seminars. Denver. Stephanie Brewer, <sbrewer@vortexfsm.com>, <www.vortexfsm.com/seminars>, +1 303.800.5526.

FEB. 12–13 ➤ Regulatory Affairs Training. JDA Aviation Technology Solutions. Bethesda, Maryland, U.S. <info@jdasolutions.aero>, <jdasolutions.aero/services/regulatory-affairs.php>, 877.532.2376, +1 301.941.1460.

FEB. 12–14 ➤ World ATM Congress. Civil Air Navigation Services Organisation and Air Traffic Control Association. Madrid. Rugger Smith, <Rugger.Smith@worldatmcongress.org>, <www.worldatmcongress.org/Home.aspx?refer=1>, +1 703.299.2430, ext. 318; Ellen Van Ree, <Ellen.Van.Ree@worldatmcongress.org>, +31 (0)23 568 5387.

FEB. 18–20 ➤ SMS Initial. Curt Lewis & Associates. Seattle. Masood Karim, <masood@curt-lewis.com>, +1 425.949.2120. (Also FEB. 25–27, Dallas.)

FEB. 19–21 ➤ Air Transportation of Hazardous Materials. U.S. Department of Transportation, Transportation Safety Institute. Oklahoma City, Oklahoma, U.S. Lisa Colasanti, <AviationTrainingEnrollment@dot.gov>, <1.usa.gov/YLcjB8>, 800.858.2107, +1 405.954.7751. (Also MAY 2–3, Anchorage, Alaska, U.S.; JULY 30–AUG. 1, Oklahoma City.)

FEB. 21–22 ➤ Safety Indoctrination: Train the Trainer. Curt Lewis & Associates. Seattle. Masood Karim, <masood@curt-lewis.com>, +1 425.949.2120.

APRIL 15–17 ➤ Ops Conference. International Air Transport Association. Vienna. <www.iata.org/events/Pages/ops-conference.aspx>.

APRIL 29–MAY 3 ➤ Aircraft Accident Investigation. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, <case@erau.edu>, <bit.ly/wtWHln>, +1 386.226.6000.

MARCH 12–13 ➤ Safety Across High-Consequence Industries Conference. Parks College of Engineering, Aviation and Technology, Saint Louis University. St. Louis, Missouri, U.S. Damon Lercel, <dlercel@slu.edu>, <www.slu.edu>, +1 314.977.8527.

MARCH 12–13 ➤ Risk Management. ScandiAvia. Stockholm. <morten@scandiavia.net>, <bit.ly/U9yyPm> , +47 91184182.

MARCH 18–20 ➤ CHC Helicopter Safety and Quality Summit. Vancouver, British Columbia, Canada. <summit@chc.ca>, <bit.ly/tmyQll>, +1 604.232.7424.

APRIL 10–11 ➤ 58th annual Business Aviation Safety Seminar. Flight Safety Foundation and National Business Aviation Association. Montreal. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/aviation-safety-seminars/business-aviation-safety-seminar>, +1 703.739.6700, ext. 101.

APRIL 11–13 ➤ Internal Evaluation Program Theory and Application. U.S. Transportation Safety Institute. Oklahoma City, Oklahoma, U.S. Troy Jackson, <troy.jackson@dot.gov>, <www.tsi.dot.gov>, +1 405.954.2602. (Also SEPT. 17–19.)

APRIL 15–19 ➤ OSHA/Aviation Ground Safety. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, <case@erau.edu>, <bit.ly/wtWHln>, +1 386.226.6000.

APRIL 22–26 ➤ Aviation Safety Program Management. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, case@erau.edu, <bit.ly/wtWHln>, +1 386.226.6000.

Aviation safety event coming up? Tell industry leaders about it.

If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early. Send listings to Rick Darby at Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or <darby@flightsafety.org>.

Be sure to include a phone number and/or an e-mail address for readers to contact you about the event.

Looking Forward to 2013

At a meeting I attended recently, one of the speakers said, in essence, that while we cannot predict the future, how we conduct ourselves today will play a big part in how things turn out. With that in mind, I thought I would share some insight into our planning and work scope for 2013.

The Foundation has six principal operating areas: membership, seminars, technical programs, communications, BARS (Basic Aviation Risk Standard) and government/political affairs. In each area, we set priorities for projects and the funding that goes into them. The leadership team, working in conjunction with the Foundation's officers and Board of Governors, produces a work plan that fits the Foundation's mission.

In the membership program, we are opening more lines of communication with a monthly e-newsletter to keep you up to date on what is happening at the Foundation. In addition, we will further develop our student membership and student chapter programs, and will continue to hone our dues structure.

Our seminar team is planning two major safety events: our Business Aviation Safety Seminar, scheduled for April 10–11 in Montreal, and the International Air Safety Summit, Oct. 29–31 in Washington. Also in the planning stages are two, or possibly three, smaller regional seminars. Keep checking our website for updated information.

In technical programs, information sharing and safety management system evaluations will be a focus. The Foundation also will continue to facilitate and participate in committee work, and we are looking at forming more partnerships to keep on top of all that is going on in the industry.

We have been working to enhance communication with our membership, and the broader aviation/aerospace industry, through improvements to our website, and that effort will continue in the new year. Also, in addition to the launch of the members-only e-newsletter, we are rolling out members-only access to select information on our website. Beginning in February, new issues of *AeroSafety World* will be available digitally only to members for the first three months following publication. After three months, digital access will be opened up to everyone. Data and information that currently reside on the website will continue to be available to all.

The BARS program, which primarily conducts audits for operators associated with the mineral and mining industry, has matured and will focus on current customers' needs while working strategically to add more BARS member organizations.

In November, we signed a memorandum of cooperation with the International Civil Aviation Organization that will enable us to expand our work with countries around the world on issues such as the protection and sharing of safety data. There will be more interaction with governments that may need our facilitation with safety issues concerning airports, air traffic control and gathering of data.

These are the primary areas that we will be focusing on. However, if there is an issue that pops up where we think we can make a difference for aviation and aerospace safety, we will jump in.

After all, that is what our members expect.

Capt. Kevin L. Hiatt
Chief Operating Officer
Flight Safety Foundation

The most effective way to protect the world's vast store of confidential aviation safety information against court-ordered disclosures that threaten hard-won risk mitigations may be for countries/regions to enact specific laws, says Kenneth P. Quinn, general counsel and secretary, Flight Safety Foundation, and vice chair of the International Civil Aviation Organization (ICAO) Task Force on Safety Information Protection.[1] His presentation during the FSF International Air Safety Seminar in October in Santiago, Chile, summarized key issues the task force has reviewed for two years and its expected finalization of recommendations to ICAO in January 2013.

The aviation industry is not immune to the application of criminal law, Quinn said, and only in recent years has it been possible to argue successfully that judicial authorities should not interfere either in accident investigations under ICAO Annex 13 or in the industry's voluntary occurrence reporting programs. "We're not going to have immunity nor should we," he said. "We're not going to have absolute protection nor should we. … We need to be sensitized to the judicial system. They need to be sensitized to us." For example, if an accident investigation reveals evidence of willful misconduct, or evidence of gross negligence, appropriate administration of justice also can benefit aviation safety, he said.

The ICAO Air Navigation Commission established the multidisciplinary task force in December 2010 in response to the recommendation by William R. Voss, FSF president and CEO, during the ICAO High Level Safety Conference the previous April and the ICAO General Assembly's instruction the previous October for the Council of ICAO to enhance protection of safety information using task force recommendations. Based on four prior meetings followed by stakeholder input in December, the task force is scheduled to deliver a report in January 2013 to Nancy Graham, director of the Air Navigation Bureau, containing recommendations for the ICAO Secretariat.

The task force has struggled to describe an ideal safety culture for all states that encourages the free flow of information without undue interference by judicial authorities or inappropriate actions by safety investigators, Quinn said.

Yet the collection and sharing of aviation safety information today are critical to risk mitigation throughout airline operations. Such programs enable aviation workers to "admit mistakes freely," he said.

Task Force Context

An important issue is that in standardizing and protecting aviation safety information, the aviation industry also has to comply with privacy laws and permit the normal administration of justice, Quinn said. "And there lies the risk" to programs built on confidentiality, he said.

Disclosures have "serious consequences, and you're collecting an ever-greater pool of information but you probably [don't realize], or don't fully realize, how little protection exists today. We're focusing a lot on what had been the existing protection, and what bothers me and a lot of people is language" that often includes a highly ambiguous exception to the protection, such as "except where a review by an appropriate authority determines that release of confidential aviation safety information is necessary for the proper administration of justice."

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SHAPING SAFEGUARDS

BY WAYNE ROSENKRANS

The urgent need for judicial 'advance arrangements' challenges an ICAO task force seeking to protect confidential aviation safety information.

Judges without education on the safety issues often have been ready and willing to require release to prosecutors of confidential safety information simply because it sounds relevant to a homicide or manslaughter charge. "Courts, prosecutors and lawyers are likely to ignore non-binding attachments or guidance material that contain ambiguous, subjective exceptions," Quinn said. "So it's great to do [judicial] training, it's great to have guidance material, but unless there is a law that the judges must follow, they will ignore it. Particularly if it's international guidance material, they will ignore it."

He cited the aftermath of the 2008 Spanair Boeing MD-82 accident, following a takeoff in which the flight crew inadvertently failed to correctly select flaps and slats, that included a leak to Spanish news media — and ultimately public Internet postings — of the final audio recording from the cockpit voice recorder (CVR). Now, Spanish authorities not only have dropped the negligent homicide charge against two maintenance technicians, he said, but "have developed an education and training seminar with their judiciary. They hosted a very large summit … and their civil aviation authority is in a dialogue with the national police, with the local police, with the judiciary … about the sensitivity now of aviation information and safety information."

A Spanish judge — who became familiar with guidance to judicial authorities in European Regulation 996/2010 Articles 12 and 14[1] — also recently denied access to draft aircraft accident reports to lawyers pursuing civil litigation. In other examples, the expertise of the French aviation accident investigation authority was used not only in the criminal conviction of two airlines, the aircraft manufacturer and a mechanic but also in their successful appeal (see "Concorde Convictions Rejected," p. 12). In Singapore, the chief prosecutor has facilitated specialization in aviation accidents among prosecutors as well as a dialogue between these prosecutors and accident investigation authorities in preparation for any future interaction, he said.

Court-Ordered Releases

In light of other court decisions worldwide, Quinn and the Foundation have seen an ominous unwillingness among some judges to seriously consider legal arguments about safety-related industry practices. One judge ruled that existing national laws allowing discovery of information — despite the chilling effect on aviation community risk mitigations — outweighed all safety-related arguments. In one Canadian civil case, lawyers for a terminated flight attendant argued successfully that the national health and safety act required the airline to release to the plaintiff's lawyers, for potential use as evidence, otherwise confidential information from a program similar to U.S. aviation safety action programs (ASAPs). In another recent Canadian civil case, the judge ruled that there was "[no] evidentiary basis for the suggestion that the disclosure of CVRs contents would have a chilling effect on pilot communications in the cockpit," Quinn said.

A U.S. magistrate similarly said there was no common law privilege or specific statute enacted by the U.S. Congress to prohibit an airline's ASAP database information from being used in court, he said.

Task Force Objective

The task force has been developing recommendations for new or enhanced

ICAO standards and recommended practices to protect aviation safety information. A concurrent project is drafting a new Annex 19 in conjunction with the ICAO Safety Management Panel, he said. This annex — covering occurrence reporting and safety management systems — will assure protection of occurrence reporting information in addition to protecting accident investigation information under Annex 13.

The scope of anticipated recommendations likely will comprise accident investigation; legal enforcement or administrative actions (such as suspension or revocation of an airman certificate/license or issuance of a letter of correction or letter of warning); responses to subpoenas and requests under the U.S. Freedom of Information Act (FOIA) and its non-U.S. equivalents from news media, lawyers and the public; and company discipline of employees. Lawyers seeking in court to establish negligence routinely file FOIA-type requests for information from aviation occurrence reporting sources, Quinn said.

New judicial education includes the aviation industry perspective that courtroom use of confidential aviation safety information should be prohibited; "unless this safety information can only be obtained by going after this source — and unless it is necessary to ensure a fair trial or [prevent] a miscarriage of justice

Conflicts in Administration of Justice and Uses of Aviation Safety Information

Event Leading to Court Action	Affected Aviation Professionals	Concerns About Chilling Effect[1]
Brazil — September 2006 A business jet and a large commercial jet collided in flight, and the airliner crashed with 154 fatalities (*ASW,* 2/09, p. 11, and 3/08, p. 12).	One military air traffic controller was convicted in October 2010 on a criminal charge but the military court acquitted four other controllers. The convicted controller was sentenced in May 2011 to more than three years of imprisonment but was eligible for community service, and another controller was acquitted on charges of harming national air transport safety. Two U.S. business jet pilots were convicted in May 2011 on criminal charges and sentenced to more than four years in prison. The judge recently commuted their sentences to community service, which has not been enforced.	The consensus of aviation safety specialists is that "information given voluntarily by persons interviewed during the course of safety investigations is valuable, and … such information, if used by criminal investigators or prosecutors for the purpose of assessing guilt and punishment, could discourage persons from providing accident information, thereby adversely affecting flight safety."[2]
Indonesia — March 2007 A large commercial jet was destroyed in a runway overrun with 21 fatalities (*ASW*, 1/08, p. 42). The non-judicial accident investigation concluded in part that the landing airspeed was twice the correct value and that the captain (pilot flying) ignored 15 warning alarms and the first officer's repeated requests to go around.	The captain of the accident flight was charged in February 2008 with six counts of manslaughter. In April 2009, the captain was found guilty of criminal negligence and sentenced to two years in jail. In September 2009, the high court overturned the captain's sentence.	The exception within aviation safety specialists' argument against the criminal prosecution of individuals is evidence of an intent to cause damage or conduct with knowledge that damage would probably result, equivalent to reckless conduct, gross negligence or willful misconduct. A chilling effect on other aviation professionals has not been not a concern in these rare circumstances.
Cyprus and Greece — December 2008 A large commercial jet crashed after decompression and occupants' loss of consciousness during cruise, with 120 fatalities (*ASW*, 1/07, p. 18).	Authorities in Cyprus charged the airline and four individuals (former chief pilot, chairman, CEO and operations manager) with 120 counts of manslaughter. A Cyprus court in December 2011 acquitted the individuals; the attorney general has appealed. A Greek court in April 2012 sentenced three executives and an engineer to 123 years in jail, reduced to 10 years for manslaughter and negligence; appeal is expected.	The Greek court used a draft accident report and final accident report by the national accident investigation authority, along with testimony from an accident investigator, as evidence in the criminal case — contrary to prevailing international practices.

Notes:

1. The term *chilling effect* in this context refers to potential unwillingness by aviation personnel to voluntarily disclose information needed to correctly determine accident causation, or to routinely report safety-related events, threats and errors in their everyday work.
2. From the *Joint Resolution Regarding Criminalization of Aviation Accidents,* signed in October 2006 by leaders of the Académie Nationale de l'Air et de l'Espace, Civil Air Navigation Services Organisation, European Regions Airline Association, Flight Safety Foundation, International Society of Air Safety Investigators, International Federation of Air Traffic Controllers' Associations, Professional Aviation Maintenance Association and Royal Aeronautical Society.

Sources: Kenneth P. Quinn and *AeroSafety World*

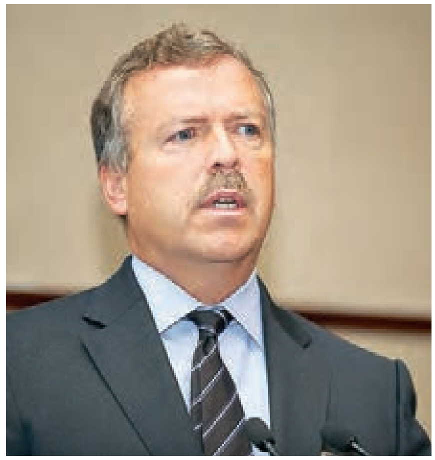
Table 1

— it does not come in, it is protected," Quinn said. Moreover, even if allowed in such circumstances, suitable safeguards must be in place such as de-identifying the information, issuing a protective order or providing an opportunity to seal the proceedings so the information is not made public except perhaps to the plaintiff's lawyers. "Otherwise, it will have a tremendous chilling effect that will negate [airline risk mitigation] programs, will stop the programs; then we'll go back to learning about safety through accident analysis," he said (Table 1).

Very liberal rules of discovery — that is, requiring defendants to turn over everything that may be relevant — prevail in trials worldwide. A better approach would be for courts to follow the standard of first considering the high-level consequences of releasing confidential aviation safety information, then deciding what can be used before a jury or a judge, Quinn said.

The European Union already has set a positive example with Regulation 996, in his opinion. "They are quickly coming up to speed on appropriate systems to have a dialogue of advance arrangements with the judiciary, with prosecutors, with law-enforcement," he said, urging all states and regions to promote this type of dialogue regardless of task force recommendations, ICAO decisions or gaps in legislation and policies of local jurisdictions.

"If you can, formalize that dialogue in terms of a memorandum of understanding in an advance arrangement," Quinn said. "Europe is providing a path forward. … [Regulation 996 Article 14] is prohibiting making the following kinds of safety information available: statements from safety investigation authorities, sensitive and personal information, information provided by third-party countries … draft reports or statements, … CVR [audio recordings or] transcripts, and communications between persons involved in the aircraft's operations."


Wayne Rosenkrans

Quinn

This regulation allows disclosure of confidential aviation safety information if the benefits of the disclosure outweigh the adverse domestic and international impact on future air safety investigations. In a related favorable note, the Eurocontrol Just Culture Task Force recently demonstrated the value of creating a model prosecution policy and conducted a dialogue with prosecutors and law enforcement officials, discussing in part the prohibition of criminal prosecution absent evidence of willful misconduct or gross negligence.

In the years since the 2006 midair collision of a Gol Transportes Aéreos Boeing 737-800 and an ExcelAire Services Embraer Legacy 600, positive changes have occurred in Brazil's standards for criminal prosecution in aviation accidents, Quinn said. The Chamber of Deputies in the Brazilian Congress "has passed recently legislation that would protect safety information and prevent its use in a criminal prosecution," he said. As in Spain, Brazilian authorities are "reaching out and doing training of their judiciary, and they've had a success," he said. "One of the judges that went through the judiciary [training] was asked to force an aerospace company to turn over safety-related information and — on the basis of that training — turned down the request."

In the United States, protections of aviation safety information against these types of court-ordered disclosures remain relatively weak after recent efforts to strengthen them under the FAA Reauthorization Act of 2012.

Despite some solid FOIA protection, Quinn said, "Be aware that all of that information can still be subject to a subpoena and civil litigation in a wrongful death case. Be aware that a grand jury can subpoena all that information, and local law enforcement can get all that information."

Typically, under FOIA-type legislation, voluntarily supplied safety information has been given greater protection than mandatorily supplied safety information, he said. "Europe is moving additionally to protect mandatorily supplied safety information. … That's going too far, and we have to recognize that the public has a right to know, the media have a right to know. If there's an accident, they ought to be able to pull up failures and malfunctions and defects. They ought to be able to pull up service difficulty reports. … There's really no chilling effect because people have to file [these reports]."

Note:

1. Kenneth P. Quinn is an attorney and partner, Pillsbury Winthrop Shaw Pittman. The IASS presentation reflected his views and those of Flight Safety Foundation, and was not made on behalf of the task force.
2. The title is *Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC.*

Safety News

Rudder Control

Eleven years after the fatal crash of an American Airlines Airbus A300-600 that was traced to excessive rudder-control inputs, the U.S. Federal Aviation Administration (FAA) has ordered action to prevent excessive loads on the vertical stabilizers of several models of A300s and A310s.

The FAA issued an airworthiness directive (AD) in November requiring either a design change to the rudder control system on all A300-600s and A310s or the installation in those airplanes of a stop-rudder-inputs warning modification.

The AD was intended to "prevent loads on the vertical stabilizer that exceed ultimate design loads, which could cause failure of the vertical stabilizer and consequent reduced controllability of the airplane," the FAA said.

The FAA said its action was prompted by "events of excessive rudder pedal inputs and consequent high loads on the vertical stabilizer on several airplanes."

Among those events was the Nov. 12, 2001, crash of the American Airlines A300 after takeoff from John F. Kennedy International Airport in New York. All 260 people in the airplane were killed, along with five on the ground.

The airplane's vertical stabilizer and rudder, and then its engines, separated in flight. The U.S. National Transportation Safety Board (NTSB) said the probable cause of the accident was the separation of the vertical stabilizer "as a result of the loads beyond ultimate design that were created by the first officer's unnecessary and excessive rudder pedal inputs. Contributing to these rudder pedal inputs were characteristics of the Airbus A300-600 rudder system design and elements of the American Airlines Advanced Aircraft Maneuvering Program."

Upgrade for Israel

Israel's civil aviation authority has been found in compliance with the International Civil Aviation Organization's (ICAO's) safety standards, according to an October review by the U.S. Federal Aviation Administration (FAA).

The FAA upgraded Israel to Category 1 status from the Category 2 rating it had received in a 2008 review by the FAA.

A Category 2 rating means that a country's civil aviation authority is deficient in at least one of several areas, including technical expertise, trained personnel, record keeping and inspections procedures. A Category 1 rating indicates compliance.

If a country is assigned a Category 2 rating, its air carriers may not establish new service to and from U.S. airports; existing service is unaffected, however.

Under its International Aviation Safety Assessment program, the FAA conducts safety reviews of all countries with air carriers that operate to the United States or that have applied for such operations.

Concorde Convictions Rejected

A French appeals court has thrown out the criminal convictions of Continental Airlines and one of its mechanics in connection with the July 25, 2000, crash of an Air France Concorde during takeoff from Charles de Gaulle Airport in Paris.

Alexander Jonsson/Wikimedia

All 109 people in the airplane and four people on the ground were killed when the Concorde burst into flames and crashed into a hotel.

The French Bureau d'Enquêtes et d'Analyses (BEA) identified the probable causes of the crash as the passage of one of the Concorde's tires over a part lost by another airplane, the "ripping out" of a piece of the fuel tank and the ignition of leaking fuel. Accident investigators said the lost part was a metal strip that had fallen from a Continental DC-10.

Published reports said that, although criminal charges were dismissed, the appeals court upheld a lower court order requiring Continental — which has since merged with United Airlines — to pay the equivalent of more than $1 million in civil damages to Air France.

Flight Safety Foundation praised the appeals court's rejection of the criminal convictions.

"We're very pleased that courts are recognizing that professional human error does not amount to criminal conduct, even where it can lead to catastrophic consequences," said FSF General Counsel Kenneth Quinn, also the vice chair of the International Civil Aviation Organization Task Force on Safety Information Protection (see "Shaping Safeguards," p. 8).

"The tragedy of this accident and others is only compounded by decades-long efforts to find someone to blame, rather than focus on human factors, training and technology to make sure that the tragedy does not reoccur," he said. "Undue prosecutorial and judicial interference can not only create further victims of accidents but, more importantly, [can] harm the integrity and timeliness of the accident investigation process, with an adverse effect on aviation safety."

Infrastructure Upgrade

The Latin American and Caribbean Air Transport Association (ALTA) and other aviation organizations have signed a declaration urging governments in the region to "facilitate the timely development of air transport infrastructure."

Others to sign the declaration during the 9th ALTA Airline Leaders Forum in Panama City, Panama, in November, included the Civil Air Navigation Services Organisation, Airports Council International (ACI), ACI-Latin America and Caribbean, and the International Air Transport Association (IATA).

IATA Director General and CEO Tony Tyler told the forum that the region's top aviation priorities are improvements in safety and infrastructure.

Airport and air navigation infrastructure "has not kept pace with rising demand for air connectivity in Latin America," he said.

He noted the 32 percent improvement in the hull loss rate for Western-built jets in the region in 2011, compared with 2010, but noted that the region lags behind the global hull loss rate. In 2011, the global rate was one hull loss of a Western-built jet for every 2.7 million flights; the rate in Latin America was one accident for every 780,000 flights.

Accident Fatalities Decline

Fatalities from aircraft accidents worldwide declined 41 percent from 2010 to 2011, the International Civil Aviation Organization (ICAO) said in its annual *Safety Report*.

A total of 414 fatalities were recorded in 2011, down from 707 in 2010, according to the report, which said the decline resulted in one of the safest years on record in terms of loss of life.

The report, published in November, also said that no fatalities were recorded in 2011 in runway-related accidents involving scheduled commercial operations. In 2010, 165 people were killed in runway-related accidents — an accident category that has been designated as a safety priority by ICAO and other aviation organizations.

Overall, there were 126 accidents involving scheduled commercial flights in 2011, up from 121 in 2010. The report said the increase was "consistent with the related [3.5 percent] increase in traffic and therefore did not significantly affect the global accident rate."

The 2011 rate of 4.2 accidents per million departures was unchanged from 2010.

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NTSB's Most Wanted

Improving safety in airport surface operations is among the U.S. National Transportation Safety Board's (NTSB's) top 10 safety challenges for 2013.

Surface operations and general aviation safety are the only aviation-specific items on the agency's list, announced in November, but several others — preserving the integrity of transportation infrastructure, eliminating distraction and improving fire safety — touch on aviation, as well as other modes of transportation.

"Transportation is safer than ever, but with 35,000 annual fatalities and hundreds of thousands of injuries, we can and must do better," NTSB Chairman Deborah A.P. Hersman said.

The NTSB called for more and better ground movement safety systems, such as cockpit moving maps and runway status lights, and for pilot training that includes simulator sessions involving gusty crosswinds and other realistic conditions.

"The problem … requires all parties involved in airport operations to work together to create a safer, more vigilant environment," the NTSB said. "Ground movement safety systems, such as cockpit moving map displays that provide a timely warning to flight crews to prevent runway incursions, are just one potential solution. Another is a system of cross-checking the airplane's location at the assigned runway before preparing for takeoff.

"New technology — such as runway status lights and enhanced final approach runway occupancy signals — can provide a direct warning capability to the cockpit, thereby eliminating the delay in warning the pilots by relaying it through an air traffic controller."

For general aviation, the NTSB recommended improved pilot education, including training on the use of electronic flight displays, and screening for risky behavior.

Other specific recommendations called for increased investment in aviation infrastructure, including engineered materials arresting systems to mitigate injury and damage from runway overruns, and improved weather information for pilots; the installation of fire suppression systems and fire retardant materials in airplane cargo compartments; and enhanced efforts to eliminate distraction in aviation and other modes of transportation.

Information Sharing

Flight Safety Foundation (FSF) and the International Civil Aviation Organization (ICAO) have begun a new cooperative effort to promote and share aviation safety information and metrics.

The new worldwide initiative is designed to support ICAO guidance for safety management systems, which calls for increased monitoring, analysis and reporting of safety data.

"The establishment of this framework for enhanced cooperation with FSF is an important step in helping us achieve the highest levels of aviation safety worldwide," said Roberto Kobe González, president of the ICAO Council. "Aviation safety knows no borders, and these types of collaborative data sharing and risk mitigation efforts are essential to help states and industry address safety risks before they lead to a serious incident or accident."

The memorandum of cooperation calls for ICAO and the Foundation to work together to encourage compliance with ICAO standards and recommended practices and related guidance material.

The memorandum also "promotes joint activities between the organizations in the areas of data sharing and analysis, training and technical assistance," according to the announcement of the agreement. "The joint analyses developed will facilitate the harmonization of proactive and predictive safety metrics and the promotion of a just safety culture globally."

Foundation President and CEO William R. Voss, noting that some U.S. air carriers and the U.S. Federal Aviation Administration already operate under cooperative data-sharing agreements, said the new cooperative agreement would help other countries "establish models that are suited to their unique needs and constraints."

Regional forums will be convened soon to aid in establishing information-sharing goals.

In Other News …

The U.S. National Transportation Safety Board has issued recommendations calling for the installation of active **fire suppression** systems in all cargo containers or compartments of cargo aircraft. … All 191 member states of the International Civil Aviation Organization have begun using a new aircraft **flight plan** designed to aid in managing the increasing volume of air traffic. … The U.S. Federal Aviation Administration, the U.S. National Transportation Safety Board, airlines and aviation labor unions have agreed to a new **information-sharing** program designed to identify systemic risks and help prevent related accidents.

Compiled and edited by Linda Werfelman.


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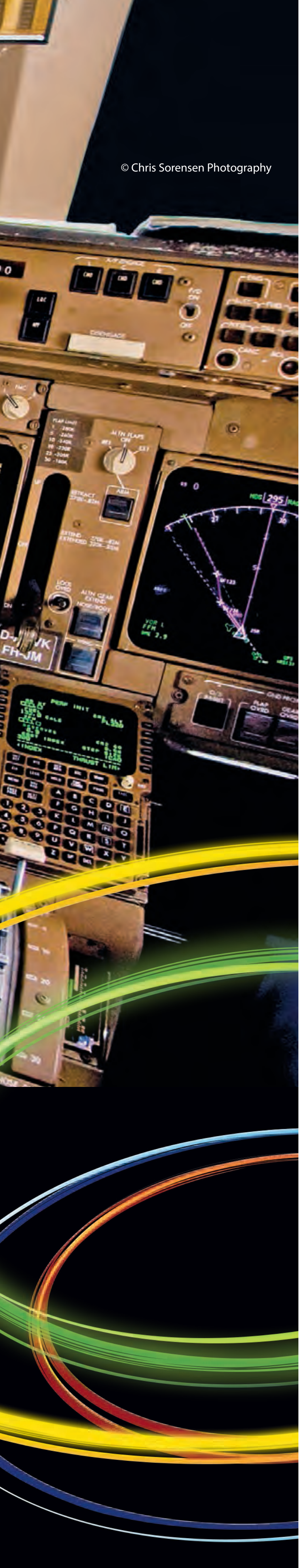
As flight deck displays become more numerous and more sophisticated, pilots grapple with sensory overload.

Attention on Deck

BY CLARENCE E. RASH



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A pilot from the pioneering days of aviation, who flew with little more than a compass for flight information, would no doubt be delighted — and overwhelmed — by the array of instruments on today's flight decks. More displays mean that pilots have more information — and that leads to improved decision making and enhanced flight safety.

However, cognitive scientists warn that providing more and more information has its limitations, increases workload and actually can negatively influence the amount of information pilots can absorb and act upon. This concern may be most important in emergency situations when multiple, simultaneous warning displays activate, overwhelming pilots with information.

This warning has not gone unheeded, as many cockpits have a declutter mode, allowing pilots to greatly reduce the number of instrument displays vying for their attention. When a declutter mode is not available, pilots often simply turn off the instruments they consider unnecessary or distracting.

Cockpit Information

The first step in avoiding the potential problem of information overload is understanding the balance between information requirements (how much information is needed) and availability (how much information is being presented or is quickly accessible).[1] How much information is required is ever-changing and depends on flight task, aircraft type and phase of flight. Information availability also depends on the cockpit instrument panel design — that is, the number and location of instruments, the types of displays and the modes of information presentation.

Equally important is the human at the controls. Pilots use multiple senses — especially sight and hearing — to gather information about their aircraft and its relationship to the outside world (i.e., situational awareness).

Although the first aviation displays were entirely visual in nature, many modern displays have both visual and auditory modalities; this is especially true of displays presenting caution and warning information.

Visual displays primarily present information using intensity (brightness), size and color characteristics. Auditory displays use intensity (loudness) and frequency (tone). Both visual and auditory displays often incorporate a pulsating characteristic, such as a flashing light or a beeping tone.

Displays can be considered as having two functional modes. The first, and most obvious, is to present current status information for various aircraft performance parameters such as airspeed and angle of climb, and to have this information always available. This is especially true for visual displays. An example is an altitude indicator. There is no need for pilots to continuously monitor this parameter, but the information is always there, for example, for timely awareness of deviation from clearances.

In a second functional mode, a display may serve as a caution or warning indicator. In this mode, the display moves from a passive to an active function. Based on certain predetermined criteria, the display alerts pilots that the current status of some flight parameter requires monitoring or immediate action. Communications systems, which are a type of auditory display, fall within this mode, as air traffic control communications regarding altitude changes or the presence of nearby aircraft require acknowledgement and possible action. Stall warning indicators are another example.

Using Displays

While all flight displays should be monitored at appropriate intervals, pilots generally interface most with the displays used during takeoff and landing and during emergency situations. During the en route phase of flight, the use of autopilot is customary, with the interface adapted for monitoring.

During takeoffs and landings, pilots use scanning techniques to systematically and

Jennifer Moore

purposefully direct their attention to the important and relevant task-defined displays. During these flight phases, pilots must monitor hundreds of sources of information within the cockpit, as well as attend to additional inputs from outside the aircraft. In general, pilots can select when and where to direct attention during most, if not all, phases of flight.

In an emergency scenario, multiple caution and warning displays generate new visual or auditory stimuli, such as red flashing lights or sirens, which are intended to capture pilots' attention. In such situations, there is a sudden shift in how pilots interact with the displays, which compete to capture pilots' urgent and full attention.

Attention

In today's fast-paced world, multi-tasking is considered the norm, and motor, visual and auditory tasks apparently are being attended to simultaneously. However, studies consistently show that overall performance suffers when attention is divided among multiple tasks.[2] The ability to absorb visual and auditory information from multiple sources is thought of as being second-nature, but the concept of attention is actually complex.

Multi-tasking is considered the norm, and motor, visual and auditory tasks apparently are being attended to simultaneously.

Attention is formally defined as the mechanism that takes place in the brain to ensure that a preferred sensory input receives immediate cognitive processing over all other inputs.[3] This definition presumes some preliminary cognitive processing, with or without attention. Attention may be better understood if it is thought of as a process that ensures continued cognitive processing of a chosen sensory input. You must actively and continuously maintain attention in order to maintain a high level of cognitive processing of a desired input. An obvious implication is that if attention is shifted from one input to another, intentionally or inadvertently, cognitive processing of the first input is greatly reduced, if not terminated altogether.

While a complete understanding of how attention works still eludes cognitive scientists, two basic tenets have been identified: Attention is limited, and attention is selective. However, details beyond these general statements remain in contention.

The principle that attention is limited leads to an appealing, but not fully accepted, idea that humans have a finite pool of attention resources that can be distributed across one or more sensory inputs (divided attention). This portrayal is useful in a first attempt to understand attention, but it fails to point out its complicated nature.

The concept of a finite pool of attention resources implies that tasks may be performed in parallel by dividing these resources. However, there is not total agreement as to whether truly simultaneous parallel attention is occurring when we divide attention between two or more tasks at the same time, or if attention is just rapidly being switched between individual sensory inputs.

Some psychologists believe that there is not one pool of attention resources but several. Even if multiple resource pools exist, some studies have suggested that resources used for visual and auditory stimuli may not be completely separate; this is more apparent when the stimuli are in different locations.[4] In the cockpit, this may translate into pilots not being able to effectively attend to both visual and auditory warnings from opposite sides of the cockpit.

Aviation psychologist Chris Wickens[5,6] has suggested a multiple resource theory for attention that says each task has three dimensions that determine how attention is allocated. These dimensions are:

- Which cognitive processing stage does the task involve — for example, perceiving a light or selecting a switch to turn on?
- Does the task involve the verbal or spatial mode of processing — listening to a communication or searching for a specific instrument readout?
- What are the types of input and output involved — auditory or visual inputs; verbal or motor outputs?

Wickens' theory argues that there may be a separate pool of attention resources for each combination of the three task dimensions and that performance deteriorates when there is a shortage of these different resources.

Difficult Tasks

Regardless of whether multi-tasking occurs simultaneously or with rapid switching, the ability to divide attention seems to depend on a number of factors.[7] A primary factor is the difficulty of the *attention task*. It is obvious that the more difficult a task, the greater concentration (attention) is required. It is possible for a task to be so difficult that divided attention is impossible. Not as obvious is that the attention resources required for a specific task do not remain constant. Training and experience can reduce the requirements.

When a task is first learned, the attention resources required can be so great that the task may be all-encompassing. With practice, the *attention demand* decreases dramatically, and the task becomes automatic. This reduction in attention demand is called *automaticity* and is the major goal of training. The mechanisms that allow for automaticity are not clearly understood. One theory suggests that with training, some of the processes involved in an attention task eventually are eliminated.[8] Another proposed explanation is that with well-practiced tasks, the increased role of memory reduces the attention demand.[9]

As might be expected, if a specific task is not performed routinely, or if a long delay occurs in the practice or performance of a task, the task's attention demand will return to previous higher levels. This inevitable regression is what is behind requirements for maintaining flight proficiency.

Task Types

Task type is another factor affecting divided attention when performing multiple tasks. For tasks largely related to attending to cockpit instruments, task type can be defined by the information input method and can be categorized as either visual, such as searching for a specific switch or reading a display value, or auditory, such as monitoring communications for your call sign or attending to an auditory display warning. Like attention in general, theories of how two or more different types of tasks compete for attention are complex and not fully understood.

An example of this complexity is in the size of the environment from which competition for attention can arise. Because humans have two ears on opposite sides of the head, we are sensitive to sounds generated anywhere around us. In contrast, the human instantaneous visual field — what can be seen when the head is in a fixed position — is limited to mostly the frontal hemisphere. Foveal vision, which provides fine detail, is further restricted to only about two degrees of the visual field.

In studies that have looked at the problem of simultaneous visual and auditory inputs, such as an indicator light flashing at the same time a tone is emitted, it was found that the tone is frequently not detected. This may imply that attention seems to favor visual input when both the visual input and the source of the auditory input are located within the visual field. However, in natural environments, sounds not collocated with a visual input can be used to draw attention to a visual target or event not in the visual field.

Selective Attention

The first generally accepted tenet of attention — that it is limited — very likely leads to the second tenet — that attention is selective. It seems reasonable that if an asset is limited, then the user of the asset would have the ability to determine where it should be used.

Selective attention is the process of choosing what to attend to. This may involve directing attention to a specific object or event, or in a general direction. Though the brain continues to receive information from the entire environment, most of this information is largely ignored. Selective attention enables a person to concentrate on the input of interest while disregarding other inputs from the environment such as engine noise, cabin conversation or changing display readouts.[10]

Selective attention is called "top-down" processing, which is goal-driven; the individual determines which stimulus receives the selective attention. This also is referred to as executive attention. This does not imply that all attention resources have been focused on the selected single object or the event of interest. The brain continues to use a "bottom-up" approach in which attention is stimulus-driven. This means that there are certain aspects — for example, color, brightness increase or loudness — of an input stimulus that can override a person's selective (focused) attention.

Attention Tunneling

Sometimes selective attention can go too far, resulting in attention tunneling. Colloquially called tunnel vision, this condition occurs when a pilot fixates on a specific input while becoming oblivious to all other incoming information. All attention resources become dedicated to a single input from one information source. This could be a specific location or specific readout on a display, or it could be some object outside the aircraft. In many cases, stress, workload and fatigue can increase the likelihood of tunnel vision.[11]

The classic experiment conducted by Fischer, Haines and Price[12] revealed that pilots flying with a head-up display (HUD) were less likely to detect unexpected runway incursions than those flying with conventional head down instruments, despite the fact that the HUD allowed direct runway viewing so that the incursion *could* be seen. The study concluded that pilots were focusing their full attention on the HUD symbology at the expense of all other visual information.

Sensory Overload

In today's instrument-rich cockpits, pilots typically encounter more information (sensory inputs) than can be processed at any one time, especially during emergency situations when multiple warnings may be flashing and chiming.[13] This can lead to a condition known as *sensory overload*.

Sensory overload causes an overdemand of cognitive resources. The theory of multiple pools of attention resources explains sensory overload as a supply-and-demand problem that occurs when an individual must perform two or more tasks that require the same resource. Conversely, overload will not occur if the multiple tasks do not make demands on the same resources. Sensory overload has long been known to cause pilot error in simulator studies[14] and is believed to be a contributing factor in a number of aviation accidents attributed to pilot error. Situations of sensory overload can cause disorientation, degrade decision-making ability, and delay or even prevent the correct response.[15]

This raises the question of whether one attention resource dominates the others. A number of studies have indicated that in most tasks, cognitive processing seems to favor visual inputs over auditory inputs.[16]

Solving the Problem

Reviews of the U.S. National Transportation Safety Board (NTSB) aviation accident database have concluded that nearly half of the reported accidents could be attributed to crew error involving lapses of attention.[17,18] Human factors experts continue to study the attention issues involving pilots and instrument displays, and to develop better guidelines for information presentation. Better guidelines, coupled with the flexibility of glass cockpits that are no longer constrained in the type and location of the information they present, may help reduce the potentially disastrous consequences of sensory overload and attention tunneling.

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In August 2013, pilots seeking to fly in air carrier operations in the United States will see a sharp increase in flight time and certification requirements. The Pilot Certification and Qualification Requirements rule, expected to be published in the *Federal Register* on May 17, 2013, amends pilot eligibility and qualification requirements and modifies the requirements for an airline transport pilot (ATP) certificate. The rulemaking, a result of the Airline Safety and Federal Aviation Administration (FAA) Extension Act of 2010, aims to ensure that pilots have more experience, especially in difficult operational conditions, before they are hired by U.S. passenger and cargo airlines.

MORE EXPERIENCE REQUIRED

New pilot qualification rule seeks to reduce accidents caused by pilot inexperience.

BY HEATHER BALDWIN

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U.S. Federal Aviation Administration, top; Susan Reed

The rule is now in executive clearance following closure of the public comment period on April 30, 2012. If published on schedule, it will go into effect Aug. 1.

Known colloquially as the "1,500-hour rule," the proposal primarily affects first officers (FOs), who will be required to hold an ATP certificate, which requires at least 1,500 hours of flight time, and a type rating for the aircraft to be flown. Currently for U.S. Federal Aviation Regulations (FARs) Part 121 and Part 135 operations, FOs are required to have only a commercial pilot certificate, which requires 250 hours of flight time, and appropriate category and class ratings.

Requirements for the ATP will change as well. An ATP certificate with an airplane category multi-engine class rating or type rating will require 50 hours of multi-engine flight experience and completion of a new FAA-approved ATP certification training program that would include academic training and training in a flight simulation training device. The training will prepare a pilot to function in multipilot and air carrier environments, in adverse weather conditions such as icing and in high altitude operations, and adhere to the highest professional standards.

The rule makes two exceptions to the 1,500-hour requirement. Military pilots with 750 flight hours and graduates of an accredited four-year university program with 1,000 flight hours[1] will be able to obtain a "restricted privileges" ATP certificate.

"Pilots with this restricted certificate would only be able to serve as first officers for U.S. airlines. They could not use it to serve as a captain in any commercial flying operation that requires an ATP, nor use it to teach other pilots," Peggy Gilligan, FAA associate administrator for aviation safety, told the House Committee on Transportation and Infrastructure's subcommittee on aviation on April 25, 2012. "Pilots seeking a restricted ATP would be tested to the same standard required for full ATP certificates, and they would be required to have the equivalent minimum instrument time and nighttime flight hours [that] a full ATP certificate would require."

Gilligan explained the reasoning behind the exception, saying, "In the 2010 act, Congress clearly acknowledged that the measurement of experience in determining when an individual may be ready to serve is not limited solely to the number of hours flown. Rather, education and other commercial flying experience must also be considered."

The requirements for captain will change, too, but less dramatically than for FOs. Under the new rule, pilots will need at least 1,000 flight hours in air carrier operations to serve as a pilot-in-command in Part 121 operations.

Background

The rule aims to reduce the number of accidents and incidents caused by pilot inexperience. In a notice of proposed rulemaking (NPRM) published on Feb. 29, 2012, the FAA said it had identified 31 accidents in Part 121 air carrier operations and 30 accidents in Part 135 air carrier operations between fiscal year 2001 and fiscal year 2010 that "could have been mitigated if the proposed enhanced ATP qualification standards and Part 121 requirements had been in effect at the time of those accidents. The analysis indicated the accidents were a result of various issues, including improper aircraft handling, poor CRM [crew resource management], poor situational awareness and inadequate training. These accidents resulted in 107 fatalities, 28 serious injuries, and 44 minor injuries."

Despite this trend pointing toward the need for increased pilot training and qualification standards, it wasn't until the Feb. 12, 2009, crash of Continental Airlines Flight 3407, operated by Colgan Air, that the issue really came into the public spotlight. On approach into Buffalo Niagara International Airport, in wintry weather conditions, the Bombardier Dash 8-400 turboprop slowed to dangerously low speeds and stalled. The captain failed to follow established stall recovery procedures, pulled back on the yoke and overrode the stick pusher, crashing into a private home.

The accident killed 45 passengers, two flight attendants, both pilots and an individual on the ground. The U.S. National Transportation Safety Board's (NTSB's) final accident report cited flight crew qualifications, failure to adhere to the sterile cockpit rule and improper handling of the aircraft as causal factors in the accident.

Shortly after the accident, family members of the passengers formed Families of Continental Flight 3407 and began pushing lawmakers for reforms they said would bring regional airline hiring and pilot qualification standards to a higher level.

"Our goal is one level of safety," said Scott Maurer, father of Flight 3407 passenger Lorin Maurer and one of the family group leaders who has been instrumental in pushing for the passage of the legislation. "We advocate very strongly for: let's get the right pilots in the cockpit and let's set them up for success. Pilot qualification is only one provision of [the law] and there's no one brick in this structure that gets the job done. You need them all."

Some argue that the new pilot qualification rule would not have prevented the Flight 3407 disaster as both pilots had more than 1,500 hours at the time of the accident (the captain had logged 3,379 hours and the first officer had 2,244 total hours). Maurer strongly disagreed. He pointed out that Colgan had hired the captain with just 618 hours; the new rule would have prevented him from being hired until he had much more experience. Moreover, the new ATP requirements would have given both pilots specific training on operating in adverse weather conditions.

Maurer said the rule has positives and negatives. "It's got all the stakeholders, and we can certainly agree with and support the exception for military pilots," he said. "But we are concerned about the university exception. We don't want to see simulators as a substitute for flying in the clouds and cold weather and ice."

Industry Reactions

Chesley Sullenberger, a retired US Airways captain and founder of consulting firm Safety Reliability Methods, has been a longtime advocate of this rule. "Not only have I tried to make sure this rule was implemented, but my FO on the Hudson River was also very active," said Sullenberger, who is widely known for successfully landing US Airways Flight 1549 on New York's Hudson River in January 2009 after the Airbus A320 struck a flock of birds. "There's a constant tension between economics and safety. I'm of the point of view that we must make these improvements for three reasons:

New Rule Will Severely Impact Pilot Hiring Pool

Q&A with Louis Smith, president, Future and Active Pilot Advisors (FAPA)

***ASW*: What has been the response of your members to the new pilot qualification rule?**

Smith: The low-time pilots are wondering how they will be able to accumulate hours. There aren't enough pilots with 1,500 hours to take the regional jobs. We are already seeing the impact: I just got an email from a large regional carrier who said they were out of pilots and can't fill their November class.

***ASW*: What is FAPA's position on the rule?**

Smith: We don't think the mandate will work at the regional airline level, given the current pay and benefit structure. The only way the regional airlines can attract high-time pilots at their current pay and benefits is to tie the offer to a major airline seniority number — not just a guaranteed interview, but a contingent seniority number with little restrictions and no further impediments to the offer.

***ASW*: How will the rule change the hiring landscape?**

Smith: Establishing a reliable source of competent pilots will be a challenge for even the major airlines. Some of the majors are now recruiting pilots from the regional airlines, which triggers instructor attrition at the flight schools and aviation universities, and the domino effect ripples through the industry. The 1,500-hour rule will reduce the pool of qualified pilots and will require radical changes in the current offer made to pilots entering at the regional level.

***ASW*: Will there be enough pilots to fill the needs of airlines?**

Smith: We don't expect a shortage at the major and global airlines but without significant pay and benefit changes, the regional airlines will experience serious shortages. One recruiter, briefing top management recently, said, "Be prepared to park airplanes next year because we don't have enough people to fly them."

FAPA is a career and financial advisory service for professional and aspiring pilots. <www.fapa.aero>.

Passengers deserve it, colleagues expect it, and the profession demands it. These improvements are long overdue."

In fact, Sullenberger, who had 20,000 flight hours at the time of the Hudson event and has studied safety his entire professional life, argued that 1,500 hours is not enough. "Two hundred and fifty hours is ludicrously, insanely, stupidly low. Going to 1,500 is a step in the right direction, but we are not all the way there." He pointed to his experience on the Hudson as an example, saying that had his first officer, who also had 20,000 hours, been a less experienced pilot, the outcome would have been very different.

"On our flight, the crisis was so extreme, the workload so high, the pressure beyond belief, we didn't even have time to have a conversation. I had to rely on his experience to intuitively understand what was happening by what I was telling ATC [air traffic control]. I had to rely on him to know when to shift his priorities," Sullenberger recalled. "When we were approaching the water, I had to judge to a fraction of a second when to pull the nose. Jeff [Skiles, the FO] knew that. Without me telling him, he immediately stopped trying to get more thrust from the engine and began calling out airspeed and altitude. He knew intuitively that he had to shift to a higher priority.

"Had I had someone with much less experience, we would not have had as good an outcome and people would have perished," Sullenberger said. "You can be surprised when you least expect it and suddenly you have only 208 seconds to solve it. So I really get the importance of having the proper experience in the cockpit."

Some have stressed that the training — not the hours — is the key piece of this proposed rule. "There's not a direct correlation between hours and safety. A pilot's experience will certainly increase with more hours but it depends

on how they accumulate those hours," said Sean Cassidy, first vice president, Air Line Pilots Association, International (ALPA) and a Boeing 737 captain at Alaska Airlines. "Are they just building hours on their own? Or are they working with a check airman on the line? Having a more structured approach to building more quality and experience is important."

Cassidy said the forthcoming rule "strikes a balance between where we are now and the experience you need to operate a large jet. It meets a lot of the goals we've identified and lines up nicely with our position that just having a commercial license isn't enough to fly passengers." He added that the industry will see safety improvements as a result of bringing up the baseline hours. "When you build up hours, you build up situational awareness. Overlay that against the more structured mentoring and leadership training and teamwork elements that will be required" and the industry will be safer as a result of the new law.

Targeted Training Crucial

"Parts of this are good," weighed in John Cox, founder of Safety Operating Systems and a retired airline captain with more than 14,000 hours. "Increasing the experience level of pilots entering flights decks is good. The old rule of 250 hours had relatively inexperienced pilots coming into complex jet airplanes."

But he added that the rule "needs polish." Specifically, Cox said he wanted to see even more training to address the problems that cause the majority of accidents. Most important, he said, there should be a formal upset recovery program in airplanes. He pointed to Boeing's 2011 *Statistical Summary of Commercial Jet Airplane Accidents*, which said that 18 of the 79 fatal accidents (22.7 percent) in the commercial jet fleet during 2002–2011 were caused by loss of control in flight. Those accidents resulted in 1,493 onboard fatalities and 80 external fatalities, more than were caused by any other type of accident. Loss of control in flight and controlled flight into terrain accidents — which also accounted for 18 of the 79 accidents — were clear leaders as the causes of accidents during the past decade.

Simulators, he said, don't effectively imitate stalls and upsets. "If you look at the animation of Colgan [Flight 3407] and Air France Flight 447,[2] the wings rolled steeply from one side to the other. Until you see this kind of instability and recognize it as a key indicator that the airplane is stalling," the likelihood of a successful recovery is reduced. "Pilots must recognize the G forces, which you can't do in a simulator."

Cox said more training is needed in high altitude flight. "When jets are [at] cruising altitude, they are in a different environment with different meteorological conditions and lower stall speeds. These things need to be addressed," he said. "We need to provide pilots training in the environment in which they will spend most of their careers." With this training, Cox said, a good second-in-command experience level would be between 800 and 1,000 hours.

His points echo the March 20 testimony of Flight Safety Foundation President and CEO William R. Voss before the U.S. Senate Committee on Commerce, Science and Transportation's subcommittee on aviation operations, safety and security. Voss told the panel that a change in training standards was needed because new technology and industry restructuring has caused the requirements of the past "to become dangerously outdated, and we are seeing some tragic consequences."

However, he added that the new rule puts too much focus on hours and not enough on the training needed to avert the kinds of tragedies that prompted the rule in the first place. "There are countless examples of pilots with many thousands of hours, who lacked the critical knowledge to avert a tragedy," he said. "The Air Florida pilots who crashed at Washington National more than 20 years ago had 8,300 hours and 3,500 hours respectively, yet still lacked critical knowledge of cold weather and deicing operations."

Voss further stated, "While the purpose of a 1,500 hour rule is understood, Flight Safety Foundation strongly supports the notion that a structured training program can allow this requirement to be reduced, since that training program would reduce risk by leaving less to chance. The Foundation believes the real effectiveness of the new rule will be more a result of mandating critical training that targets risk in the real world, rather than simply increasing the number of hours."

Notes

1. This provision applies to graduates with an aviation degree if they also obtained a commercial pilot certificate and instrument flight rating from a pilot school affiliated with the university or college.
2. Air France Flight 447 was an Airbus A330-200 that crashed into the Atlantic Ocean on June 1, 2009, killing all 228 people aboard. The final accident report by the French Bureau d'Enquêtes et d'Analyses said ice crystals had blocked the pitot tubes, producing unreliable airspeed information, and excessive control inputs led to a stall.

FALLING

European nations aren't keeping up with the schedule for advancing the Single European Sky, EC officials say.

The Single European Sky (SES) project is "not delivering" on its promise of a seamless and efficient air traffic management system throughout Europe, Siim Kallas, European Commission (EC) vice president for transport, says.

To address shortcomings in creation of the single European airspace, Kallas plans to introduce a series of legislative proposals early in 2013 to speed implementation of the program and strengthen its legal framework.

Industry groups echoed Kallas' remarks and endorsed his legislative plans as a top priority in European aviation.

"The Single European Sky is … too important to be allowed to fail," Kallas told an October 2012 meeting of top European aviation officials. "We have fallen seriously behind in our original ambitions. After more than 10 years, the core problems remain the same: too little capacity generating the potential for a negative impact on safety at too high a price. There are some signs of change, but overall, progress is too slow and too limited. We need to think of other solutions and apply them quickly. There is too much national fragmentation. Promised improvements have not materialized."

The impetus for SES, according to an EC timeline, came with the liberalization of the European Union's aviation market in the 1990s and the resulting expansion of air services. Between 1993 and 2012, air traffic in Europe increased 54 percent, the EC said.

The increase in air traffic and the accompanying constraints on airspace capacity caused flight delays, attributable in large part to what the EC called "fragmented and inefficient" air traffic control in Europe (see "European Airspace," p. 28).

"Airspace is currently structured around national boundaries, and so flights are often unable to take direct routes," the EC added. "To make a comparison, in an airspace which is roughly the same size, Europe has more than 30 en route air navigation service providers, and the USA has just one. The USA serves twice as many flights as Europe with the same costs."

SES is based on two legislative packages. The first, begun in 2004, is SES-I, which separates regulatory authority from service through the creation of national supervisory authorities and air navigation service providers.

The second, begun in 2009, is the five-part SES-II, which deals not only with regulating performance, providing technological solutions through the SES Air Traffic Management Joint Undertaking (SESAR JU), maximizing airport capacity and incorporating human factors concerns, but also with uniformly addressing safety concerns, in part through the European Aviation Safety Agency.

After SES is fully implemented, Kallas said, safety will improve "by a factor of 10," airspace capacity will triple and costs will be halved.

Without SES, "chaos will reign," he added.

The EC sees progress in implementing some elements of SES, especially in the separation of service providers and the bodies that regulate them, the creation of national supervisory authorities and the harmonization of some technical systems. Service providers have achieved prescribed standards in their safety management systems, and some airspace classifications have been harmonized, the EC says. In addition, airspace use has become more flexible and is operated as "a single continuum

BEHIND

BY LINDA WERFELMAN

© Chris Sorensen Photography

… to satisfy the needs of all users at the time they need it," the EC says.

The EC considered 2012 a key year for implementation of SES, with one element of the program calling for the establishment by Dec. 4, 2012, of nine Functional Airspace Blocks (FABs) — designed not according to national boundaries but instead according to traffic flow patterns — as an intermediate step toward SES. However, only two FABs are in place — one for the airspace over Scandinavia and a second for airspace over Ireland and the United Kingdom.

Enforcement Action

The EC said that, "to ensure the necessary progress," it would use its existing enforcement authority against countries that fail to take the steps required to implement SES, including the steps needed to establish FABs. In early 2013, it will seek additional enforcement powers.

"The commission will present proposals to make sure these regional air traffic management blocks deliver real operational improvements," the EC said. "They will be required to develop strategic and operational plans at FAB level. It is not enough to exist on paper; FABs must deliver real operational results swiftly."

Other proposals will be aimed at strengthening the SES legal framework in general and in several specific areas, including performance targets for increased airspace capacity and lower costs. In addition, proposals will address EC authority to require member nations and the FABs to "deliver the agreed targets," to reinforce powers assigned to the network manager for Europe for more centralized route planning and to strengthen the separation of service providers from national regulators.

Parliamentary Resolution

The European Parliament passed a resolution in October calling for the merger of national air traffic control airspace across Europe to enhance safety and reduce air traffic congestion, flight times and flight delays.

Jacqueline Foster, a member of the European Parliament from the United Kingdom and sponsor of the resolution, said SES is needed if Europe is to have "proper, efficient use of airspace and 21st century technology for traffic management."

She added, "Airspace across much of the EU is so congested that it faces the prospect of massive gridlock in a matter of years. We need more efficient and integrated handling of air traffic, which would be delivered by the Single European Sky."[1]

'Back on Track'

Tony Tyler, CEO and director general of the International Air Transport Association, said his organization fully supports Kallas in his efforts to "put the long-delayed SES project back on track."

Citing delays in the establishment of FABs, Tyler said that the airspace blocks are crucial steppingstones to "a fully functional SES."

He added, "If states are not delivering, then top-down action from the Commission is critical, and we would fully support infringement [enforcement] procedures by the Commission to force states to comply with their obligations."

The European Business Aviation Association (EBAA) also praised Kallas and his supporters for "having voiced so forcefully their frustration

European Airspace

European airspace is controlled by 27 national air traffic control systems, which operate 60 air traffic control centers and provide services to aircraft in more than 650 sectors.[1]

Airspace is structured around national boundaries, making direct routes from one country to another often impossible. The European Commission says that the fragmented airspace adds an average of 42 km (26 nm) to every flight. Extra costs associated with the resulting inefficiencies total about 5 billion euros annually.

European Union data show that about 1.4 billion passengers fly from Europe's 440 airports every year and that 27,000 controlled flights occur every day — about 10 million flights a year.

Air traffic is expected to increase about 5 percent every year, with about 17 million flights by 2030.

By comparison, the EC says that U.S. air traffic management is twice as efficient as the EU's, with twice the number of flights "for a similar cost, from a third as many control centers."

The EC estimates that establishment of SES will result in a tenfold increase in aviation safety, a tripling of airspace capacity, a 50 percent reduction in air traffic management costs and a 10 percent reduction in harmful environmental effects attributed to air traffic.

— LW

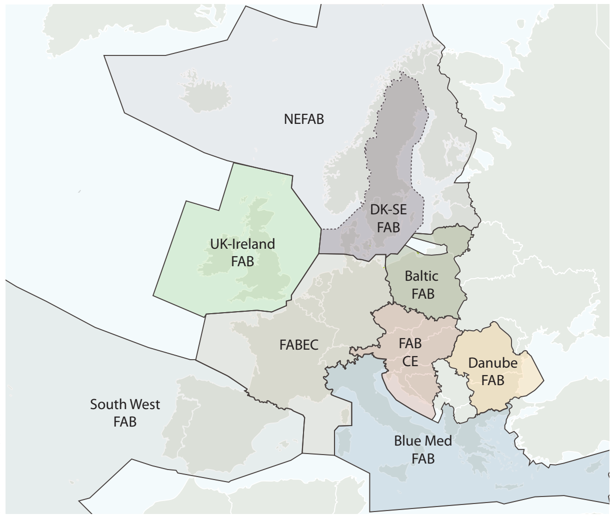
Note

1. EC. "Single European Sky: 10 Years on and Still Not Delivering." <europa.eu/rapid/press-release_IP-12-1089_en.htm?locale=en>.

over the lack of decisive action taken by member states and for having unequivocally condemned them for failing to make the changes needed to deliver the benefits of the Single European Sky initiative."

EBAA CEO Fabio Gamba said his organization "firmly stands behind the commission to do whatever is necessary, including enforcing infringement procedures, to put this crucial programme back on track as soon as possible."

The Civil Air Navigation Services Organisation (CANSO) said that its members "fully acknowledge that air navigation service provision needs to change and urge the Commission to take full account of the need for [providers] to make investments to realise both the infrastructure and the social aspects of this transformation."



Jennifer Moore

The EU's functional airspace blocks (FABs) are arranged according to traffic flow, not national boundaries.

Maurice Georges, chairman of the CANSO European CEO Committee, added, "The complexity of realising the SES, together with a more business-oriented approach to European air traffic management, should not be underestimated. Any transition, and specifically one such as the SES, needs full common understanding of the issues and close cooperation of all involved partners."

Note

1. CANSO. "Comment: Time to Deliver the Single Sky." *Airspace* Issue 19 (Quarter 4 2012): 16–17.

Unstable

BY LINDA WERFELMAN

The Falcon 10 touched down too fast and veered off the landing runway at a Toronto airport.

The flight crew of a Skycharter Dassault Falcon 10 flew a fast, unstabilized approach to Toronto/Buttonville Municipal Airport (CYKZ) after a six-minute flight from a nearby airport, overshooting the runway centerline before the airplane touched down and veered off the pavement, accident investigators said.

Neither of the two pilots — the only people in the airplane — were injured in the June 17, 2011, accident, which damaged the airplane's nose, right wing, slats and engines.

The Transportation Safety Board of Canada (TSB), in its final report on the crash, cited the "unstabilized approach with excessive airspeed" and "the lack of adherence to company standard operating procedures and crew resource management, as well as the non-completion of checklist items by the flight crew" among the accident's causes and contributing factors.

The flight began with takeoff at 1500 local time from Toronto's Lester B. Pearson International Airport. The crew completed the "After Takeoff" checklist and began a climb to 5,000 ft above sea level (ASL); at 1501, air traffic control (ATC) altered the clearance to 4,000 ft.

Less than one minute later, ATC cleared the pilots to descend to 3,000 ft. Over the next 30 seconds, the airplane descended, reaching a groundspeed of 290 kt, and the crew tried repeatedly to read back the clearance, at one point switching radio frequencies to reach a controller who could receive the transmission.

At 1503:25, the Toronto area control center controller cleared the Falcon for a contact approach to Runway 33 at Buttonville. The report said the controller included instructions to "begin the descent and to keep the approach tight, as there was traffic to follow.

"At that point, the aircraft was approximately 3.0 nm [5.6 km] from the airport, descending through 2,600 ft ASL with a groundspeed of 230 kt and heading towards the threshold of Runway 33 on a tight left base."

At 1503:40, while the Falcon was 1.6 nm [3.0 km] from the runway threshold and descending through 1,900 ft at a groundspeed of 220 kt, the pilots turned right to fly a wider left base.

The pilots were cleared to land as the airplane descended through 1,400 ft at 210 kt, about 0.3 nm [0.6 km] from the inbound track to the runway.

"The aircraft leveled out from the right turn and was heading in an eastward direction," the report said. "It flew through the inbound track at a transverse angle of about 120 degrees at approximately 1 nm [2 km] final. In an attempt to regain the runway centreline, the aircraft banked left, exceeding 30 degrees of bank. The aircraft overflew the runway centreline by approximately 0.3 nm."

At 1504:20, a "pull up" alert was sounded by the ground-proximity warning system (GPWS), and the first officer, using "a low tone of voice and … non-standard phraseology," called a missed approach, the report said. "The captain responded but continued the approach."

Another "pull up" alert followed, as the captain called for full flaps and entered a steep bank to the right on short final.

At 1504:49, the Falcon "touched down hard on the main landing gear in a nose-high attitude, then immediately departed the runway surface to the right," the report said, estimating the airplane's goundspeed at less than 110 kt.

Braking and steering responses were minimal because of the grass surface, and the Falcon struck a runway/taxiway identification sign before it crossed a taxiway intersection and stopped. About 1506, the pilots shut down the engines and exited through the main cabin door.

Pilot Experience

Both the captain and the first officer held airline transport pilot licenses, and both had undergone recurrent training, including crew resource management training, in the Falcon 10 in January 2011. The two were always paired as a flight crew, and they flew only the accident airplane. They had flown 10 hours in the 30 days before the accident and 28 hours in the 90-day period before the occurrence.

Dassault Falcon 10

CambridgeBayWeather/Wikimedia

The Dassault Falcon 10, an executive-transport, twin-turbofan business jet first produced in 1973, was a scaled-down version of the Mystère 20/Falcon 20. It was designed to seat up to seven passengers and had a maximum takeoff weight of 8,500 kg/18,740 lb, a maximum cruising speed of 494 kt and a range (with four passengers and a 45-minute fuel reserve) of 1,918 nm/3,555 km.

Source: *Jane's All the World's Aircraft*

The captain had 12,000 flight hours, including 4,000 hours in the Falcon 10; the first officer had 7,100 flight hours, including 475 hours in the Falcon 10. Both had been off duty for about 60 hours before the accident and both had been well-rested, the report said.

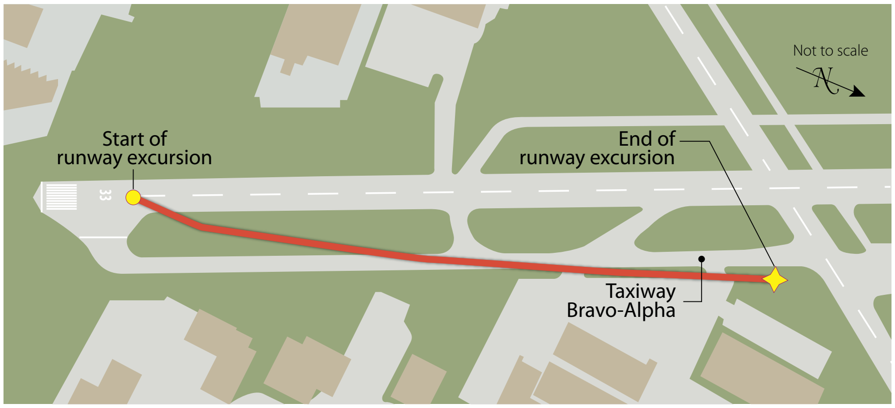
They did not typically fly this route or other short flights, the report added.

The accident airplane, which had been in service with the operator for about 20 years, had 12,697 hours total time and was maintained according to current regulations and an approved maintenance program.

The company's standard operating procedure (SOP) called for its flight crews to use the Falcon 10 checklist for all flights, with "no deviation from these procedures … unless the captain determines that the safety of flight may be compromised," the report said. During the accident flight, the pilots used the checklist until after the takeoff phase of flight but not for cruise, pre-descent, approach and landing.

In addition, the crew did not make the standard callouts required if there are deviations from the specified airspeed, altitude, localizer or glideslope, and if the angle of bank exceeds 30 degrees, the report said.

Susan Reed



The TSB said the Falcon veered off the runway immediately after it touched down.

Skycharter's SOP required its flight crews to conduct a missed approach if aircraft did not "meet the approach window criteria within 500 ft above touchdown," the report said. Those criteria included that indicated airspeed be plus or minus 10 kt of the approach speed and not lower than V_{REF} (the reference landing speed, usually defined as 1.3 times stall speed with full landing flaps or selected landing flaps); that the airplane be within a one-dot deflection of the localizer and glideslope; and that the airplane be in landing configuration, except for full flaps.

"According to the SOP, the airspeed for a visual flight rules (VFR) pattern should be 160 kt on the downwind leg of the circuit, 140 kt on the base leg and V_{REF} plus 10 kt on the final approach," the report said. "Prior to takeoff on the occurrence flight, the crew determined that V_{REF} was 117 kt for the calculated landing weight of 17,000 lb. The aircraft was cleared to fly directly to CYKZ and joined the circuit on base leg. At this point, the aircraft's calibrated airspeed was 186 kt."

Canadian Aviation Regulations prohibit operation of aircraft at airspeeds of more than 250 kt below 10,000 ft ASL or more than 200 kt below 3,000 ft above ground level or within 10 nm (19 km) of a controlled airport, unless ATC authorizes a higher airspeed.

The report noted that a 1999 Flight Safety Foundation study found that unstabilized approaches were causal factors in 66 percent of 76 approach-and-landing accidents that occurred from 1984 to 1997.[1]

"In this occurrence," the report said, "there were several indicators of an unstabilized approach. These included excessive bank angle, activation of the GPWS, late extension of flaps, excessive flight-parameter deviations when crossing the minimum stabilization heights, and deviation down to the runway threshold."

The report noted that the Skycharter SOP did not include procedures to be followed in case of a GPWS alert and added that operators without such procedures "may place crews and passengers at risk in the event that a warning is received."

'There Was No Need'

The report said that, "considering the entire flight was approximately six minutes in duration and below 4,000 ft ASL, there was no need to fly at the speeds attained during the flight. Although radar indications provided groundspeed values, it was determined that, even after the conversions to indicated airspeed values, the aircraft was flown in excess of the current regulations and Skycharter's SOP."

"The excessive speed, and the fact that the crew did not routinely fly this route or other short routes, reduced the amount of time available to perform all the tasks dictated by the company SOP, the required checklist items and the approach briefing. This resulted in the crew flying an unstabilized approach."

Because of the excessive speed, the airplane overshot the final approach track as the crew attempted to comply with ATC's request to "keep the circuit tight," the report said, noting that the Falcon's airspeed was about 140 kt as it passed through the final approach course and that at one point it entered a left turn with more than 30 degrees of bank. At that point, the report said, "the distance to the runway threshold continued to reduce quickly, and manoeuvres to regain runway heading became more aggressive and non-standard."

The report also noted among the accident's causes and contributing factors that "the captain's commitment to landing or lack of understanding of the degree of instability of the flight path likely influenced the decision not to follow the aural GPWS alerts and the missed approach call from the first officer" and that "the non-standard wording and tone used by the first officer [in his call for a missed approach] were insufficient to deter the captain from continuing the approach."

This article is based on TSB Aviation Investigation Report A11O0098, "Runway Excursion: Skycharter Ltd., Dassault Falcon 10 C-GRIS, Toronto/Buttonville Municipal Airport, Ontario, 17 June 2011." The report is available at <tsb.gc.ca/eng/rapports-reports/aviation/2011/a11o0098/a11O0098.asp>.

Note

1. Flight Safety Foundation. "Killers in Aviation." *Flight Safety Digest* Volume 17–18 (November–December 1998/ January–February 1999).

The BEA's arduous path to its final report on Air France Flight 447 yields insights for the world's investigators and pilots.

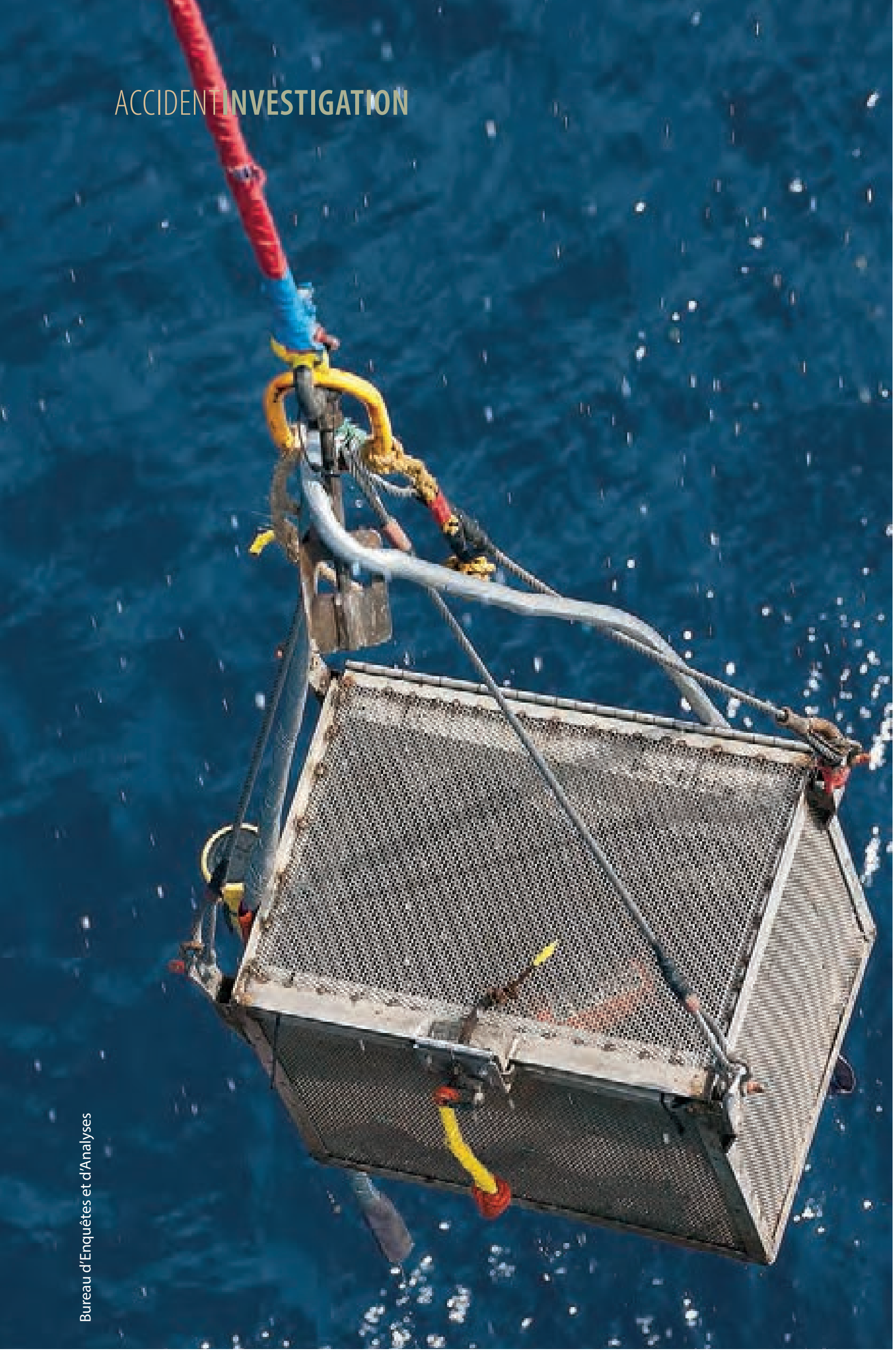
Time to Reflect

Bureau d'Enquêtes et d'Analyses

BY WAYNE ROSENKRANS

Looking back, a few of the key people responsible for investigating the June 1, 2009, crash of Air France Flight 447 see the event itself and the resulting professional demands as extraordinary on many levels. For 23 months, uncertainty pervaded their expectation of finding, much less extracting critical data from the sunken wreckage of the Airbus A330-200 in the South Atlantic (*ASW,* 8/12, p. 14), they say.

"An exceptional mystery … surrounded the exact circumstances of the accident, as the aircraft had disappeared without any message from the crew and beyond radar coverage," said Jean-Paul Troadec, director, Bureau d'Enquêtes et d'Analyses



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Behind the scenes, undersea recovery of the A330's DFDR (previous page and above) and CVR on May 1–2, 2011, yielded information requiring a new human factors working group.

(BEA), the civil aviation accident investigation authority of France. "These circumstances were only clarified thanks to the readout of the recorders in May 2011. … This accident had its origins in the obstruction of the pitot probes by ice crystals and, as a consequence, the temporary loss of airspeed indication. But above all, however, it resulted from the airplane exiting its flight envelope through the crew losing situation awareness."

Troadec joined two investigators and a media representative from BEA — and conveyed the views of Alain Brouillard, investigator-in-charge — during presentations in August 2012 of their inside perspective of the bureau's AF 447 challenges and related thought processes. They spoke and answered questions during the ISASI 2012 Forum in Baltimore, Maryland, U.S., presented by the International Society of Air Safety Investigators.

Paul-Louis Arslanian, BEA director when the accident occurred, had made the recovery of the crash recorders the highest priority. "Without the readout, the investigation could not be conclusive — even if the examination of the parts recovered at the surface of the sea and the data collected from the aircraft message [containing maintenance data transmitted via the aircraft communications addressing and reporting system (ACARS)] gave some indication on the accident," Troadec said. "It was only on 2 April 2011, during the fourth phase of underwater searches, that the wreckage was [located]. The recorders, quickly recovered, could be read out in their entirety after spending two years at a depth of 3,900 m [12,795 ft] under water. … We then needed to understand the reason of the pilots' action, and how the loss of airspeed indication alone could have led to such a disaster."

The AF 447 investigation "sadly …was also exceptional in the number of violations [by third parties] of the ethics of safety investigation, which require respect for the confidentiality of working documents that are not published by the investigating authorities," Troadec said. "Finally, there was an exceptional level of controversy and unjust accusation against the BEA investigators, whose professional integrity and impartiality were called into question."

Another major difficulty proved to be the public's misunderstanding of the scope of BEA's mission and how France divides judicial and nonjudicial responsibilities (see "Shaping Safeguards," p. 8). A safety investigation "does not seek to determine responsibilities, that being the role of the judicial investigation that takes place in parallel and independently from ours as laid down under French law," Troadec said. "Unfortunately, in the mind of the public, it is not always easy to understand the difference. Many people expected from the BEA investigation that it would point out responsibilities and even culpabilities."

After three interim reports, the final report on the accident was published July 5, 2012, at <www.

bea.aero/en/enquetes/flight.af.447/rapport.final.en.php>. At the forum, two BEA investigators focused on the readouts of the digital flight data recorder (DFDR), cockpit voice recorder (CVR) and memory chips in other devices; and analysis of human factors pertaining to flight crew actions. (This article omits a fourth presentation on BEA interactions with the news media and families of the 228 crash victims.)

Recorders Fulfill Hopes

Léopold Sartorius, an investigator who served as head of the systems and equipment working group, described exhaustive preparations for the imagined scenarios if the DFDR and CVR were recovered, and for performing readouts of data — including readiness to replace any components on circuit boards or even to cut open memory chips, if necessary, to directly read data bit-by-bit under a microscope. "Everyone was expecting the flight recorders to help; at least we were hoping they would help," he said. Then a development in a parallel investigation raised a worst-case specter.[1]

"The accident in Comoros … was puzzling us somehow because the flight recorders were recovered after 60 days at a bit more than 1,000 m [3,281 ft] deep," Sartorius said. "There was a very high level of corrosion. The memory boards … were quite badly damaged, and there was physical damage [not only] to some small components but also to some memory chips. So … even after weeks of extensive work on the chips themselves, with help from the [U.S. National Transportation Safety Board], by the way, we could not recover all the data, from the CVR especially." The sea floor in areas of the AF 447 search was about four times deeper, and the elapsed time was 10 times longer. "We had no idea whether we would spend two days or two years trying to read out those memory chips — they were the very same type of recorders," he said.

Theoretically, unlike in Comoros, where the water salinity and temperature are relatively high, the location of AF 447 recorders provided a good chance for preservation. "Specialists say that at this depth, the water is almost clear [and contains] almost no salt," he said. "It is very cold, like 0–1–2 degrees C [about 32 degrees F]. … From the time the flight recorders would be recovered, we knew we would have 10 days more or less before we would get the recorders [into] the BEA."

The reason was that BEA did not have custody of the recorders; rather, the French Ministry of Justice transported the recorders to BEA, allowed BEA to work on them and then stored them away from BEA to ensure legal traceability, Sartorius said.

"We tried to be as prepared as possible to deal with any type of damage," Sartorius said of the advance procedural visualization. In reality, when technicians opened the DFDR, there was huge relief. "We expected a little corrosion or completely corroded [circuit boards] … but nobody was expecting something perfect like that," Sartorius said. "The CVR, well, it was a bit different." CVR memory chips were in good condition, and the damage was confined to readily repairable resistors, capacitors, memory address devices and similar parts.

BEA investigators were anxious to analyze the DFDR and CVR data in light of pre-crash maintenance message data captured via ACARS. The delays in receiving the recorders were used productively to formulate hypotheses about the ACARS message, pre-identify a parameter subset of immediate interest, validate preliminary

On May 13–14, 2011, after visual inspection revealed no damage to the DFDR memory board, the protective coating was removed, followed by 36-hour oven drying, testing and data extraction.

Bureau d'Enquêtes et d'Analyses

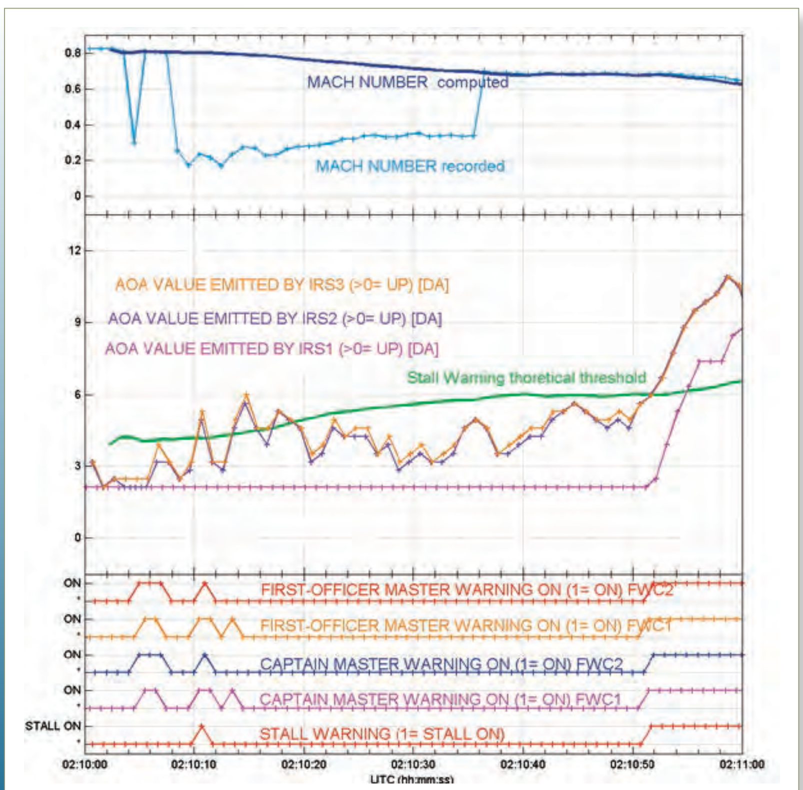
findings and settle on other working hypotheses among other tasks.

Just minutes after obtaining the DFDR data in May 2011, the first 30 plots of the first parameter subset were generated. "In a few hours, we got hundreds of parameters [of a total of 1,300 nominally available] and everyone was just overwhelmed at that," he said. Among needed-but-missing data were parameters from the right-side primary flight display — where the pilot flying (PF) was seated — and those for the position of flight director command bars.

Data recovered from computers helped investigators pinpoint the start and end — about 30 to 40 seconds apart — of the pitot probe blockage–unreliable airspeed–autopilot disconnect sequence, which was not a causal factor in the final report. "The autopilot disconnection and the reversion to alternate [control] law and some other consequences were due to at least two of the three pitot [probes] getting blocked by ice crystals," Sartorius said.

Success in recovering the flight data helped BEA recreate what instruments had presented to the pilots. Showing an animation of the instruments, he said, "And from this moment, what's quite interesting is if you look at the thrust and pitch parameters, it's not so easy to understand what's going on — especially that you are stalling. Because as you can see [in] this type of attitude, the pitch is, let's say, between 0 and 10 degrees nose up and the thrust is fine. It's just fine. The thing is, the airplane is stable in a position it will not get out of by itself, and the pilots will never finally do what could have been necessary to retrieve [recover] the control of the airplane."

BEA investigators' final report showed the change over time in the three recorded angles-of-attack and a calculated theoretical threshold at which the stall warning was triggered.



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Human Factors Prioritized

The wealth of data generated so quickly prompted BEA to change the original organization of four working groups after launching the AF 447 investigation, BEA investigator Sébastien David told the forum. In July 2011, BEA's third interim report added descriptive factors about the event.

"A lot of questions were raised with the analysis of the data from the flight recorders, but right after the release of the [third] interim report, it was decided to open a human factors working group," said David, who was selected to be its head.

The first phase of the human factors investigation sought to identify why human actions could lead to a breakdown in the safety defenses. The second phase sought to determine how these safety defenses affected the expected behaviors and skills of the crew in the situation they encountered. "This involved identifying the failures that occurred during the flight in relation to the explicit and implicit safety expectations," David said.

Analyzing Crew Performance

This working group first analyzed the behavior and performance of the flight crew during the 50-second interval from autopilot disconnection to triggering of the stall warning. This analysis included the pilots' detection of the problem, control of the flight, identification of the situation, attempt to control the flight path, and resumption of handling the airspeed anomaly.

Among other tasks, the working group looked at what occurred in the time elapsed from the triggering of the continuous stall warning to a selected point several seconds after the resting captain's return to the flight deck. He provided an example of comparing working group expectations with what actually had occurred.

"Human operators notice [anomalies] and act according to their mental representation of the situation and not to the real situation," David said. "The probability and the speed of detection of anomalous signals [are] connected … to the salience of these signals. And depending on the frequency of the human operator's exposure to the anomaly during his training or his real operation, his response may be automatic, applying rules or … on the basis of in-depth knowledge. … We also expect, when there is a sudden anomaly, that the crew will react in an expected time frame."

Regarding airspeed display anomalies, the accident crew first would be expected to control the flight path, then to identify loss of consistency in the indicated airspeed, and then to manage this anomaly with the procedure provided by Airbus to Air France, David said.

In writing the final report, BEA investigators could not be sure that the accident crew was aware of anomalies in airspeed displays before the autopilot disconnection, however. "But since the salience of the speed anomaly was very low compared to the autopilot disconnection, signaled by a visual and aural warning, the crew detected the problem with this disconnection and not the airspeed indicator," David said. "The crew was very surprised, which was analyzed by the human factors group as normal" for the cruise phase.

In light of the flight data analysis, one of the most perplexing aspects of the subsequent responses of the PF — after initial nose-up flight control inputs that were dependent on invalid indicated airspeed — was his persistent nose-up input. "We gave four or five possible explanations for the persistence of the nose-up input by the pilot flying. … Those nose-up inputs contributed to destabilize the flight path, which had a major impact for the identification and the awareness of the situation," he said.

"The startle effect due to the autopilot disconnection, associated with the destabilization of the flight path, led to … a degradation of the CRM [crew resource management], a degradation of the communication … between the two pilots. … So they were unaware of the situation, and they totally lost the control of the situation."

Lingering Questions

The investigators pointed forum attendees to the final report to read all the possible explanations of the AF 447 flight crew's non–situational awareness of the stall, including the possibility that while "very stressed with a high emotional factor," they had not perceived the aural stall warning.

In response to questions about today's practical understanding among pilots of built-in protections against flight-envelope deviations when the airplane is operating under normal control law versus alternate control law or direct control law — and the salience of instrument indications when a reversion of control law occurs — David said that the final report recommends training improvements in this area of knowledge and practice.

"I think it's a key question, an excellent question for the accident because what we need to make clear is, effectively, when the airplane is in normal law — when all the functions of the airplane are working well, for sure you can do whatever you like and especially, pull on the stick as strong as you want — and the airplane will stay in the flight envelope. That's how it's designed. Now in that specific [AF 447] case, the blockage of pitot [probes] made the flight control system switch from normal to alternate law, and the main consequence of this change was basically that there were no envelope protections anymore. … We don't really know how far [the AF 447 pilots] understood the consequences of the switch to alternate law. … What we analyzed is that, effectively, it may make a difference in … that people today may not be as trained as they could be — or maybe as they should be — in laws different from normal law because, in [cruise] operation, it never happens," David said.

He said one of the accident's most important lessons was proper response to disconnection of the autopilot in cruise at Flight Level 350 [approximately 35,000 ft], not this airplane's reversion from normal control law to alternate control law.

Ultimately, the AF 447 crash left these investigators with indelible impressions and commitments to possible ways the worldwide industry will be able to mitigate the risk of recurrence. Troadec said, "Clearly, we can still increase the level of automatic systems, improve the reliability and present protections. But in the end, safety will still depend — above all — on getting the right adequacy between the cognitive capacities of pilots and the signals that are provided to them to understand and act on. This accident has also taught us that hypotheses used for safety analysis are not always relevant, [that] procedures are not always applied by the crew, and that warnings are not always perceived."

Note:

1. The June 30, 2009, fatal crash of a Yemenia Airways Airbus A310 in the Indian Ocean off the coast of Moroney in Comoros heavily involved the BEA in leading an undersea search campaign, Sartorius said.

The International Cabin Safety Conference looked at ways to improve flight attendant and passenger survivability.

Cabin Fever

BY RICK DARBY | FROM AMSTERDAM

A flight attendant can become, with little or no prior notice, the first responder at an accident scene. "That requires him or her not only to know what to do when notified of an impending emergency, but also when to take action without being notified," said Gary Morphew, senior advisor and instructor at $(L/D)_{max}$ Aviation Safety Group. As the keynote speaker at the International Cabin Safety Conference, held in Amsterdam in October, he outlined safety issues concerning cabin crewmembers, many of which were discussed by other speakers.[1]

Morphew

"Flight attendants are trained for emergency evacuations, and all the evidence shows they do their job well in such difficult conditions," Morphew said. "But it's important that they be encouraged to talk about their experiences afterward. Management often isn't very encouraging about this, but should be.

"When the evacuation works well, everyone wants to know. And when things don't go as well, everyone wants to learn from the cabin crewmembers' experience."

Morphew outlined what he sees as today's most important challenges in cabin safety. Besides sharing of cabin crewmembers' narratives of emergency events, he listed training for runway overruns, survivability investigations, mitigating turbulence injuries and fatigue management.

"Runway overruns are one of the more common accident types, and result in more fatalities and injuries than the more dramatic and better publicized runway incursions," Morphew said.

"The flight crews are well trained in dealing with these events. But once the flight attendants are strapped in their seats for takeoff or landing, they don't actually have to *do* anything except be alert. I'm sure they try to be, but takeoffs and landings are such a routine experience for them that it would be surprising if the attention didn't wander sometimes."

More research into survivability factors in accidents is needed, he continued.

"Any cabin injuries should be thoroughly investigated, not just recorded and tallied," he said. "We might be surprised at what we learn about factors involved. And cabin configurations have many variables. Operators can revise them fairly quickly. Business class equipment is constantly being upgraded to lure these all-important customers. The seats and amenities are designed for comfort, but has anyone thought about their safety implications in an accident?

"At the other end of the economic scale — and the other end of the plane, the back end — you have another consideration if seat spacing has been reduced. Think of 29-in [74-cm] seat pitch. Yes, civil aviation authorities conduct evacuation demonstrations with different seating configurations, but even the most 'realistic' evacuation test cannot match the conditions in an actual emergency — if only for psychological reasons. A participant always knows in the back of his or her mind, the worst that can happen in a simulated evacuation might be a sprained ankle."

Although he believes any cabin safety–related event should be thoroughly investigated, Morphew acknowledged that commercial motivations play a role: "They want to get that aircraft back into service as soon as possible."

Turbulence is the most common source of flight attendant injuries, he said, adding, "Better procedures to reduce the threat have evolved. Still, we need to make further progress. When any flight attendant becomes incapacitated, it isn't just a problem for the individual. It means that flight attendant may no longer be an effective first responder in a survivable accident."

Probably every airline flight attendant in the world has experienced fatigue on the job.

"Fortunately, today fatigue risk management systems [FRMS] are taken seriously by regulators and operators," he said. "Technology is lending a hand, too. Jeppesen Systems offers the CrewAlert iPhone application for fatigue data collection.

Continued on p. 41

Learning From a Cabin Pressure Loss


Hutchings

Kris Hutchings is manager, Inflight Safety, for Canada's WestJet Airlines. He led the investigation of a loss of cabin pressure in a Boeing 737-600 at 41,000 ft. The pilots donned their oxygen masks, and because the loss of cabin pressure was not explosive they were able to warn the flight attendants and passengers with a public address system announcement prior to commencing the emergency descent.

***ASW*: What action did you and WestJet take immediately following the incident?**

KH: The crew was immediately pulled from duty and contacted by our leadership team to ensure their well-being. They were then deadheaded home and had a safety debriefing with our Inflight Safety team the following day.

***ASW*: Who was included in the safety review team (SRT) that you convened?**

KH: An SRT is composed of a lead investigator; leaders responsible for corrective action plans [CAP]; required stakeholders, as identified by the lead investigator and/or the leader responsible for CAP; and a Safety Services representative.

***ASW*: What did they find specifically relating to the cabin crewmembers and cabin procedures?**

KH: The cause of the depressurization was not attributed to the cabin crew. However, the execution of their decompression procedures allowed us to identify opportunities for improvement with our current procedures. Specifically, we identified the operation and differences of the fixed oxygen masks located in the galley compared to those located in the cabin; the effects that chemical oxygen generators have on the cabin environment (heat, smell and smoke); the stowage of fixed oxygen masks for landing after deployment, specifically the masks in the galley that hang over the aircraft doors; and procedural differences between a rapid decompression and a gradual loss of cabin pressure.

***ASW*: How were these findings communicated to WestJet management?**

KH: Inflight Management is a member of the SRT and was responsible for developing corrective actions for these findings.

***ASW*: What corrective actions were taken?**

KH: Changes were made to our training programs — initial and recurrent — and to our flight attendant manual to address the four findings just mentioned. We also sent out safety communications to all our flight attendants to make them aware of the incident.

— RD

Cabin Crew Checklists: A Safety Innovation?

Hendren

Jeffrey Hendren is supervisor–training, Cabin Safety & Crew Performance, at Canadian North Airlines. His work includes responsibilities related to flight attendant training, evaluation, the flight attendant manual, first aid and regulatory compliance.

***ASW*: We have heard that the practice of medicine has incorporated some SOPs from aviation. What have "they" learned from "us"?**

Jeffrey Hendren: Pilots researching human factors, as well as external experts — in some cases consulting with medicine and social psychology — helped drive the momentum of what we have learned in aviation about human factors and the importance of breaking barriers. Through incidents such as the Kegworth disaster involving British Midlands Flight BD 92 in England in 1989,[1] we have learned about tangible (e.g., flight deck door) and intangible (e.g., cabin crew hierarchy) factors that create fatal communication barriers.

It's natural that medicine would relate what we have learned about these barriers to the hospital operating room. Doctors are the "pilots," and nurses and other medical professionals are analogous to the flight attendants; we face the same type of barriers and stereotypes. In many surgical suites, we are starting to see a "preflight" operating team briefing between the surgeons, anesthetists, nurses and assistants; much like our safety demonstrations, the patient is also included in the briefing.

What medicine has really started to embrace is the checklist. There are simply too many steps, too many things to remember, so the checklist helps to ensure the medical professionals have reviewed each of their responsibilities and contributions to the team, assessed hazards for both the patient and the professional (e.g., needle sticks), have reinforced the protection of the sterile zone around the surgical patient, and have a protocol for adverse events. Hospitals using checklists have measured reductions in rates of post-surgical infection, medication error and patient mortality.

***ASW*: Can aviation, particularly in cabin safety, learn from medical practices?**

JH: That is the really exciting part for us in the cabin safety world. Medicine is generating fresh ideas with compelling evidence-based research. The way that some hospitals have adopted checklists is unusual. You might think that the surgeon would be the one conducting the checklist, but what they have found in some cases is that it can be more effective if the circulating nurse runs the checklist. We can take our CRM [crew resource management] skills to the next level by challenging the hierarchy in the cabin in a similar way. Instead of the captain always running the preflight briefing, we can increase engagement and demonstrate how communication is everyone's responsibility by rotating the source of the briefing.

***ASW*: Your presentation concerned checklists for cabin crewmembers. Why are they needed? Are all cabin crewmember actions currently memory items only?**

JH: I can't speak for all airlines, but my research has revealed the majority of airlines provide very little in the way of checklists for cabin crew. You will almost always find an emergency landing checklist in the flight attendant manual. You may find a preflight equipment inspection checklist, but the vast majority are not mandatory, and often leave a lot of room for interpretation.

When we look at pilot duties, they have almost no memory action items. All duties, including those that one might consider normal or routine, are backed up with a checklist. So why not extend the same strategies to other in-flight operations that include multiple steps and many individuals contributing to the team? Flight attendants are just as fallible as any other human being, and air operators and the regulators should consider that when developing standard operating procedures and the inclusion of checklists into normal, abnormal and emergency situations. Take something like arming doors; though uncommon, there are incidents of blown slides [*ASW*, 7/07, p. 22]. Could a checklist help prevent or reduce the occurrence?

***ASW*: You conducted a survey of flight attendants at Canadian North about their views on including more checklist items. What did you find out?**

JH: We were not shocked to discover that 80 percent of flight attendants polled do not use the optional preflight equipment checklist. We were impressed to see that 85 percent of flight attendants polled would view positively a mandatory formal checklist system. We learned that 92 percent of respondents believe a checklist will help to trap errors. When it comes to communication, 85 percent of respondents feel that they would be far more comfortable raising a concern or challenging a fellow crewmember when an error is made if they had a checklist to back it up.

***ASW*: What is the next step?**

JH: We will test several checklists. This phase will use sample checklists of various designs and content to determine what works best for flight attendants. There are always two pilots, but in the cabin, we can have anywhere from one to five flight attendants, and that creates a challenge on how the checklist can be completed. There is also a concern about becoming too dependent on checklists, so we still need to encourage the out-of-box thinking adaptable to different situations in the cabin.

After proving the checklists' design and usage, we will have to decide which procedures require a checklist, and how to capture that in our manuals and training programs. Checklist discipline is something that plays a large role in pilot training, and currently there is no direction from the regulator on checklist discipline for flight attendants.

***ASW*: How do you expect the industry and regulators to react to the idea?**

JH: Implementing a checklist program is far less costly than other innovations that are currently being discussed. Ultimately, the safety culture of the operator will determine whether the crewmembers buy in or not. At Canadian North, we have a strong safety culture, and our flight attendants are engaged and passionate about what they do.

It is not on regulators' radar at the moment. Transport Canada is currently occupied with the implantation of SMS [safety management systems]. But cabin checklists are very much in line with the spirit of an SMS. We need to ensure that any initiatives include performance metrics that will help back up our hypotheses and prove our outcomes.

Note

1. The accident occurred on final approach to East Midlands Airport, Kegworth, Leicestershire, England. The aircraft struck the embankment of the M1 motorway short of the airport, with 39 passengers killed immediately and eight more later dying from their injuries. The U.K. Air Accidents Investigation Branch accident report said that the cause was "the incorrect response of the flight crew" to a fan blade fracture of the no. 1 engine, mistakenly throttling back the no. 2 engine.

The report said, "Although the cabin crew immediately became aware of heavy vibration at the onset of the emergency, and three aft cabin crew saw flames emanating from the no. 1 engine, this information was not communicated to the pilots."

— RD

"Moreover, the Jeppesen Crew Fatigue Assessment Service (CFAS), which is Web-based, makes it practical to perform a systemwide assessment of planned and actual crew pairing or rostering, using the Boeing Alertness Model to measure fatigue. You can efficiently survey a route, a fleet or your entire operation — and it's now available to all airlines, large or small. It integrates into an SMS [safety management system] or FRMS.

"The chances are, CFAS will be widely used for flight crews. For cabin crews? We'll see."

Note

1. The proceedings of the conference have been published by its sponsor, $(L/D)_{max}$ Aviation Safety Group. Phone +1 805.285.3629; in the United States and Canada, toll-free, 877.455.3629.

The Cabin Scene in an Emergency Landing

Steve Hull is aviation director for RTI based in London. He has more than 41 years of airline experience, including 38 years with British Airways. His career has included more than 8,500 flight hours as a flight engineer on the Boeing 747 and Concorde. In his presentation, "Do We Heed Lessons Learned From Accidents?" he cited the U.K. Air Accidents Investigation Branch report's description of what it looked and felt like in the cabin of British Airways Flight 38, a Boeing 777, as it landed short at London Heathrow Airport, an accident ascribed to dual-engine rollback from flow restrictions caused by ice that detached within the fuel system (*ASW*, 2/10, p. 20).

- "There was no time for the flight crew to brief the cabin crew or issue a 'brace, brace' command;
- "The cabin crew initiated the evacuation;
- "The captain initially gave the instruction to 'evacuate' over the VHF [very high frequency] radio, but ATC [air traffic control] informed him of this, [and] he then repeated it over the cabin PA [public address] system;
- "Some passengers attempted to retrieve personal items during the evacuation;
- "The evacuation alarm was perceived by the cabin crew as sounding 'faint' in the cabin;
- "The evacuation alarm was later found to operate OK, except at [door 1 left], which was silenced due to a stuck reset switch; [and,]
- "Nine of the 32 premium economy video monitors detached from the seat backs during the impact."

© U.K. Air Accidents Investigation Branch

BY MARIO PIEROBON

Perfect Performance

Global safety implications of Europe's first PBN 0.1 implementation quickly became obvious.

In March 2012, Atlantic Airways, the flag carrier of the Faroe Islands, became the first European airline to use required navigation performance with authorization required (RNP AR) 0.1 procedures on a commercial flight.[1]

"At the time of landing — around 4 p.m. — the western Atlantic winds had spread a mass of low-level clouds above the channels and fjords of the Faroe Islands. We could only see the spines of the mountains," said Andrea Artoni, an aeronautical journalist, aviation consultant and a former air traffic controller who was aboard the delivery flight of the Atlantic Airways Airbus A319. The new aircraft was equipped with the RNP navigation system.

"The pilots consulted the approach chart. Tension was palpable. The weather conditions forced the pilots to use, starting from the very first flight, the special instrument approach procedure which determined the decision of the airline to purchase exactly that aircraft with exactly that equipage," said Artoni.

The equipment aided a perfect landing and since has enabled the airline to improve airport access and service reliability at its operationally demanding Faroe Islands base. The RNP navigation system installed on the Atlantic Airways A319 uses sophisticated positioning equipment to enable pilots to conduct approaches and takeoffs in challenging weather conditions that are typical in the Faroe Islands, an archipelago under Danish rule situated between the Norwegian Sea and the North Atlantic Ocean. The system also guides pilots along the non-linear approach path to Vágar Airport, necessitated by the high terrain at either end of the runway.[2]

Efficient Navigation

RNP is a category of procedures under performance-based navigation (PBN), an overarching concept comprising different levels of precision in navigation procedures without specifying the technology used to achieve them. Also included under PBN is area navigation (RNAV), the

An Atlantic Airways Airbus A319 flew Europe's first RNP 0.1 approach in March. The flight was into Vágar Airport in the Faroe Islands.

broadest category of PBN procedures. The main difference between RNAV and RNP is that RNP equipment includes alerting and monitoring systems allowing pilots to constantly monitor, on the flight management system display, the RNP precision value in nautical miles. Furthermore, RNP instrument approach procedures are flown with the autopilot selected and using only satellite signals. PBN allows aircraft to fly flight paths more precisely than previous standards, and without the necessity of having a direct link between a ground-based navigation aid (NAVAID) and an aircraft navigation system, thus allowing improved operational efficiency and better utilization of available airspace.

PBN can be considered a framework for "defining a navigation performance specification along a route, during a procedure, or in airspace within which an aircraft must comply with specified operational performance requirements. It provides a simple basis for the design and implementation of automated flight paths and for airspace design, aircraft separation and obstacle clearance. It also offers a straightforward means to communicate the performance and operational capabilities necessary for the utilization of such paths and airspace. Once the performance level (i.e., the accuracy value) is established on the basis of operational needs, the aircraft's own capability determines whether the aircraft can safely achieve the specified performance and thus qualify for the operation."[3]

Under PBN, generic requirements are defined on the basis of operational requirements. "Operators then evaluate options in respect [to] available technology and navigation services, which could allow the requirements to be met. An operator thereby has the opportunity to select a more cost-effective option, rather than a solution being imposed as part of the operational requirements. Technology can evolve over time without requiring the operation itself to be revisited as long as the requisite performance is provided by the RNAV system."[4]

The expected benefits of widespread PBN usage include reduced fuel consumption and greenhouse gas emissions and relief of congested airspace. A relatively large proportion of the global airline fleet already is equipped with PBN navigation systems. According to Marcello Astorri, an air navigation systems consultant and former airline pilot, "The world's 10 largest airlines have 97 percent of their fleets equipped with RNAV capability, while 47 percent of their fleets are equipped with RNP systems." The problem, however, is that the operational approvals to actually navigate in accordance with PBN are still relatively few. "Only 23 percent of the world's 10 largest airlines' fleets have operational approvals to fly RNP approach procedures in accordance with ICAO's [International Civil Aviation Organization's] PBN Manual," Astorri said during a technical seminar in Rimini, Italy, in September. The seminar was organized by Artoni as part of AIRET, a technology trade fair.

Safety Implications

The enthusiasm of airlines to use PBN procedures, the legislative activity of regulators with regard to PBN and the consequent need of air navigation service providers (ANSPs) and airports to adapt to a new operational and regulatory environment should be managed with a focus on the safety implications of such a technological, operational and cultural shift in air navigation. "While it is true that technological innovation, both at hardware and software levels, on the ground and airborne, offers a real help for the increase of safety within all aspects of air navigation, it is also true that the introduction of new systems and procedures can create a situation of confusion and work overload to users, which can endanger the level of safety. Especially in cases of operational disruption, when the failure of automatic systems can create a situation of uncertainty, and operators can find it difficult to carry on their tasks, it can be complicated to understand what is happening and what to do once the disruption is over," said Mauro Barduani, an air traffic control (ATC) officer and an air traffic management (ATM) and safety scholar.

There is a range of possible threats in the transition to PBN, and they are of concern to all stakeholders involved, namely air operators, ANSPs, airports and regulators.

The primary consequence of PBN implementation is a change in the airspace concept under which such navigation procedures are performed. "Validation of an airspace concept involves completing a safety assessment. From this assessment, additional safety requirements may be identified which need to be incorporated into the airspace concept prior to implementation," said ICAO. "Four validation means are traditionally used to validate an airspace concept: airspace modeling, fast-time simulations (FTS), real-time simulations (RTSs), and live ATC trials." If the changes in the airspace concept are consistent, then a combination of the four means may be necessary.

Airspace modeling is a beneficial first step because it provides some understanding of how the proposed implementation will work while not requiring the participation of controllers or pilots. "Airspace models are computer-based, so it is possible to make changes quickly and effectively to ATS [air traffic service] routes, holding patterns, airspace structures or sectorization to identify the most beneficial scenarios (i.e., those that are worth carrying forward to more sophisticated types of validation). Using a computer-based airspace model can make it easier to identify non-viable operating scenarios so that unnecessary expense and effort [are] not wasted on more advanced validation phases. The main role of the airspace model is to eliminate non-viable airspace scenarios and to support the qualitative assessment of further concept development," according to ICAO.

An FTS is a more sophisticated assessment than airspace modeling, and it "returns more precise and realistic results, while still not requiring the active participation of controllers or pilots; however, in terms of data collection and input, preparation can be demanding and time-consuming," ICAO said.

RTSs realistically replicate ATM operations and require the active participation of proficient controllers and simulated or "pseudo" pilots. "In some cases, sophisticated RTS can be linked to multi-cockpit simulators so that realistic flight performance is used during the simulation. One of the difficulties that can be encountered with real-time simulation is that the navigation performance of the aircraft is too perfect. Aircraft in RTS may operate with a navigation precision that is unrealistic, given realities of weather, individual aircraft performance, etc. In such cases, error rates from live operations are analyzed, and these can be scripted into the RTS," reported ICAO.

Live ATC trials are used to verify operating practices or procedures when subtleties of the operation are such that FTS and RTS do not satisfy validation requirements.

The initial safety assessment for the airspace concept validation should be performed in parallel with the identification by all stakeholders of more specific issues associated with transition to PBN.

SOP Redesign

PBN procedures "improve the predictability and efficiency of the flight paths but require additional coordination and planning. … The increased predictability and consistency of the PBN transitions can in some cases limit the flexibility the controller has in providing vectors close in to the airport," according to a GE Aviation white paper published in July.[5]

"From an airline perspective, flight crews must be provided with training and policies to ensure that they are aware of conditions where the PBN path places the aircraft within range to unintentionally capture the final segment," stated GE Aviation.

The redesign of standard operating procedures (SOPs) will ensure compliance with the new PBN regulatory requirements — whichever these will be — as well as navigation within the required safety levels. "However, there may still be terrain-challenged airports where placing the PBN path within range of final segment guidance may be necessary," the white paper said.

Regulatory Coordination

Regulatory adaptation and the definition of international standards is a long and delicate process, but it is necessary to ensure minimum levels of safety all around the world. The problem is not specifically that there could be differences in PBN regulation between different regions of the world. The issue is rather that in politically integrated regions like the European Union, where there are 27 national aviation authorities (NAAs), regulatory inconsistencies may be generated because it is a competence of the NAAs to implement legislation promulgated at Community level, including the PBN-related implementing rules under development. "So far, even if there exist some standards of reference, namely ICAO's PBN Manual, several operators and countries continue to utilize their own 'parameters,' in particular with regard to maintenance regulations and minimum levels of service," said Barduani.

It becomes necessary, therefore, that each ANSP not only complies with the regulatory requirements of the competent authority to which it is subjected, but also that it keeps up to date with the PBN-related regulatory differences existing among different countries, in particular those among the countries where the PBN operations are most frequent.

Workforce Resistance

"A reluctant behaviour on the side of the workforce [during] the evolution towards PBN concerns the natural human tendency not to be always available and open to technological changes, especially if such changes lead to increased workloads and reduced personnel for certain types of assignments, which could become completely automated," said Barduani.

Clarifying to the workforce the reasons for change — operational efficiency and market competitiveness — can be useful in addressing the workforce's reluctance to change. Such a response can be supported and complemented by a carefully weighed system of incentives targeted at individual workers demonstrating proactive adaptation to new technologies and practices. The basis of such a system of incentives may be the quantity and quality of observations made by the organization's leaders with regard to how their PBN procedures are implemented.

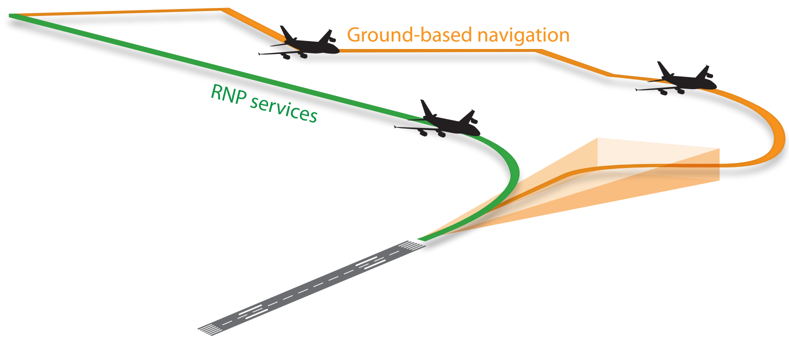
Knowledge Gap

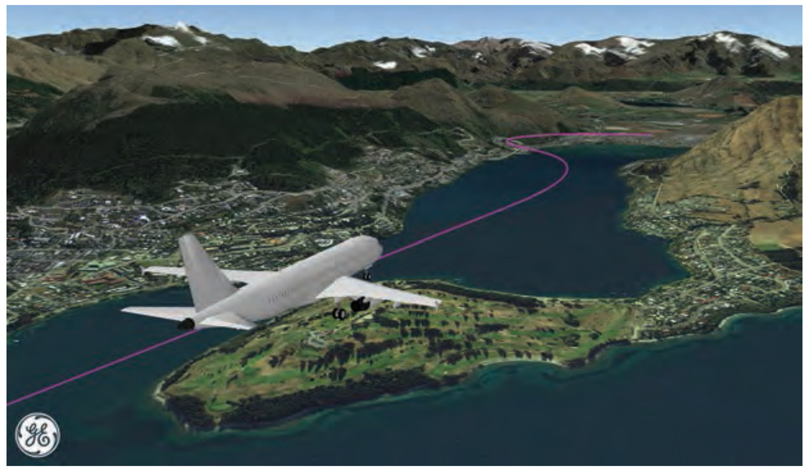
It is likely that before and at the beginning of the transition to PBN, an organization may not have the required technical knowledge to manage the transition. As a matter of fact, there is a need to retool flight crews, dispatchers, operational personnel and safety experts in air transport regulation and economics in light of PBN.

"The increased emphasis on training activities in the domain of PBN represents a significant evolution from the tradition of didactic training in air navigation," said Astorri. "If we consider the intricacies of the new RNP approach procedures, which require higher attention from the pilot with regard to the fly-ability of the procedures and the increased need of qualifications released by the NAAs, the response of the operators will have to be focused on combining together a cross-cultural approach in PBN fundamentals, a new syllabus for RNP-rated flight crews to be conducted in a high-performance simulation environment and the organizational certifications."

In addition to PBN-specific training, a further element that should be recognized is the need for more targeted training in threat and error management, crew resource management, and command and decision making for flight crews. "There is indeed a risk of increased complacency as pilots no longer actively use and search the inputs from the traditional navigation infrastructure and only need to concentrate on maintaining the precision of the on-board navigation system, which is ensured by the autopilot and the accuracy of satellite signals," said Astorri.

Beyond the flying community, PBN-specific training also will have to be provided to ANSP personnel, aeronautical information services personnel, airport operators and military personnel, when necessary.





© GE Aviation

The three-dimensional precision of RNP flight paths facilitates optimized profile descents and continuous descent arrivals with idle thrust while reducing aerodynamic noise.

Traffic Increase: Airspace

The forecast increase of traffic in ATM systems represents a significant threat even if, as expected, PBN makes airspace management run more smoothly. During the transition to PBN, safety can be enhanced by the sharing of relevant information among key stakeholders. "Under SESAR [Single European Sky ATM Research], there are provisions for a SWIM (system-wide information management) ATM information model. SWIM has been designed to allow communication, develop programs, and transfer and share information in a simple way, in order to permit users to acquire data without the necessity of specific and deep knowledge of the system's features. The concept is to create a 'system of systems,' and to reach this goal, it is necessary that all operators have access to a shared information and data system. From the perspective of ATM, widespread cooperation is essential to define optimal aircraft flight paths, thus allowing [ATM] to [transition] towards trajectory-based operations (TBO)," said Barduani.

Traffic Increase: Airports

Airports also will face traffic increases because PBN allows more reliable operations to and from a given airport and thus more movements to and from the same airport. "According to a forecast [by] Eurocontrol, approximately 20 percent of the future air traffic demand could be not accommodated, mainly because of the lack of capacity at European airports. Even if there is still capacity at other levels, like en route airspaces, there will likely be constraints at airport level, representing a real bottleneck for the whole system," said Barduani.

In addition to the necessary infrastructural investments to increase capacity at airports, an airport collaborative decision making (CDM) platform can help the ATM network to plan in advance a strategic flow management and give precise timing to airports for the utilization of their infrastructure and services. "The concept is difficult to implement but allows for higher predictability and punctuality, permitting airports to be more flexible, use their infrastructure efficiently and on time according to the demand, reduce delays and taxi times, switch slots among flights, [and] plan in advance recovery actions in case of disruption," said Barduani.

Safety Planning

Initial identification and assessment of risks, followed by their mitigation, should be the basis of further safety planning by all PBN stakeholders. Activities and time schedules to be used and respected should be identified; responsibilities among the members of safety teams should also be split. Objectives and targets of the safety action should be defined and reference safety indicators listed and outlined.

In the field of ATM, the safety indicators can be considered as the workload, the situational awareness, the losses of separation, the usability (the measure of the ergonomics and fitness for use of any work tool), the errors, the teamwork, the level of trust, the acceptability (level of trust in the effectiveness of a system or procedure for the execution of tasks) and the degree of skill degradation due to automation.

"Safety planning at the level of the single operator should also consider issues associated [with] the systemic interdependencies which characterize transition to PBN" said Michael Grüninger, an aviation safety consultant and formerly a flight inspector at the Swiss Federal Office of Civil Aviation. Among the systemic interdependencies which could give rise to safety issues, he listed a lack of cooperation among key stakeholders, a poorly defined and managed interface, a deficit of competences, a deficit in the visualization of the new system and an unsuccessful identification of the peculiarities, such as aircraft and approach design.

"An increased systemic complexity results in stronger interdependencies and an increasing amount of issues which cannot be solved on a stand-alone basis. What changes with PBN with regard to safety planning is an increased awareness of the implications of one's decisions and actions in the context of an even more complex and interactive system. With the transition to PBN, there will be an even stronger need to make well-thought decisions coordinated among all players and stakeholders," said Grüninger.

Notes

1. As explained in "Preparing for PBN," by Frances Fiorino in *Avionics Magazine*, February 2011, RNP AR "requires the highest level of navigation performance. … A value of 'RNP 0.3' means the aircraft is capable of remaining within 0.3 nautical miles to the right or left of center line 95 percent of the time within a defined containment area; RNP 0.1 means an aircraft must remain within 0.1 nm."

2. Shepherd, Lesley. "Atlantic Airways Airbus A319 First in Europe to Use RNP." <www.eraa.org/publications/industry-news/872-atlantic-airways-airbus-a319-first-in-europe-to-use-rnp>.

3. FAA. *Roadmap for Performance-based Navigation – FAA – Version 2.0,* July 2006.

4. ICAO. *Performance-based Navigation (PBN) Manual (Doc 9613 AN/937), Third Edition,* 2008.

5. GE Aviation. *PBN to xLS: Implementation Today*. GE white paper prepared by Naverus, Inc., 9 July 2012.

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BY RICK DARBY

Not all emergency exits are equal at evacuation time.

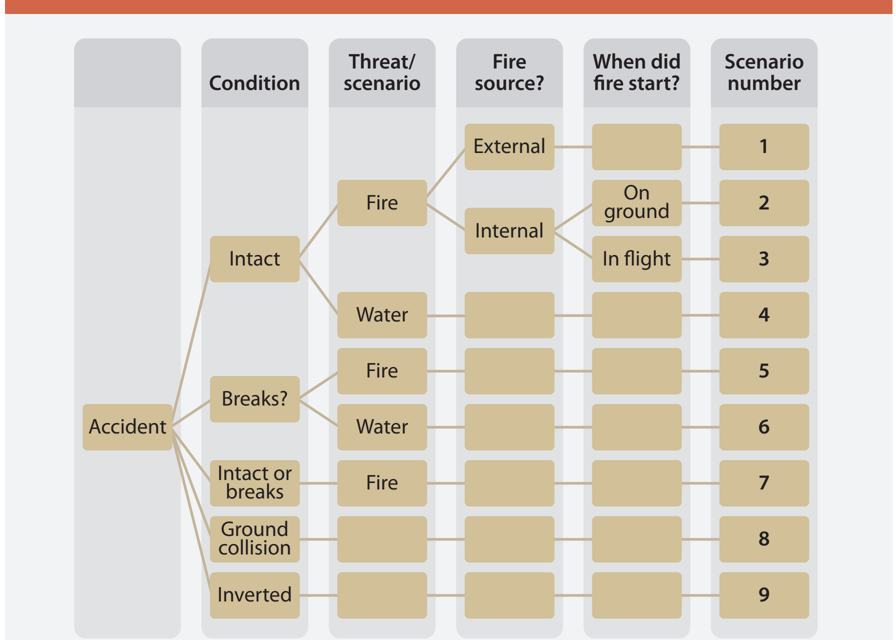
This Way Out

In 90 commercial jet evacuations from 1961–2011, on average about half the available exits were used, and in only one case were all the available exits used. Those were among the findings presented by Fons Schaefers of SGI Aviation at the 2nd International Cabin Safety Conference in Amsterdam, Netherlands, in October.[1]

"All these accidents were survivable but life-threatening because of fire or submersion in water," Schaefers said. "In situations requiring urgent evacuation, exits can make the difference between life and death. But how often are exits used in such critical situations?"

Surprisingly few attempts have been made to analyze exit usage in relevant accidents, he said. The Amsterdam presentation was an update of a similar presentation given in 1994, adding data from 1993–2011.

Nine Evacuation Scenarios



Source: Fons Schaefers

Figure 1

Accidents meeting the criteria for inclusion in his latest study database totaled 150.[2] Of those, the reports for about 90 accidents included enough information to draw useful conclusions concerning exit usage. In 51 of the 90 accidents, the number of evacuees for each exit was known; in 39, data showed only which exits were used and not how many evacuees they served.

Various criteria can be present or absent in accidents in which evacuation is required. To clarify exit usage under different conditions, the accidents were grouped into nine scenarios (Figure 1). In addition, exits were numbered according to location, both for aircraft with wing-mounted engines (Figure 2) and those with fuselage-mounted engines (Figure 3).

The number of evacuees per exit was known in only some of the accidents in each scenario. Because the known-to-unknown ratio varied among scenarios, the numbers of evacuees per exit may suggest differences but are not directly comparable. By the same token, not all aircraft have the same number of exits, so differences in usage do not necessarily indicate the efficiency of an exit position.

Scenario 1: Land — Intact — External Fire

This was the most common scenario, representing 42 of the 150 accidents in the database. In this type of accident, the aircraft came to rest on its landing gear, fuselage or a combination. "Intact" refers to the condition of the fuselage.

The overall exit usage rate was about 50 percent. Location 1, the farthest forward, was most used for evacuation in this type of accident.

Scenario 2: Land — Intact — Internal Fire Started on the Ground

This scenario led to seven evacuations. The overall exit usage rate was about 70 percent, with location 1 most commonly used, followed in frequency by location 3.

Scenario 3: Land — Intact — Internal Fire Started in Flight

Only four accidents in the database met the criteria for this scenario. These accidents had

Numbering of Exits, Wing-Mounted Engine Aircraft

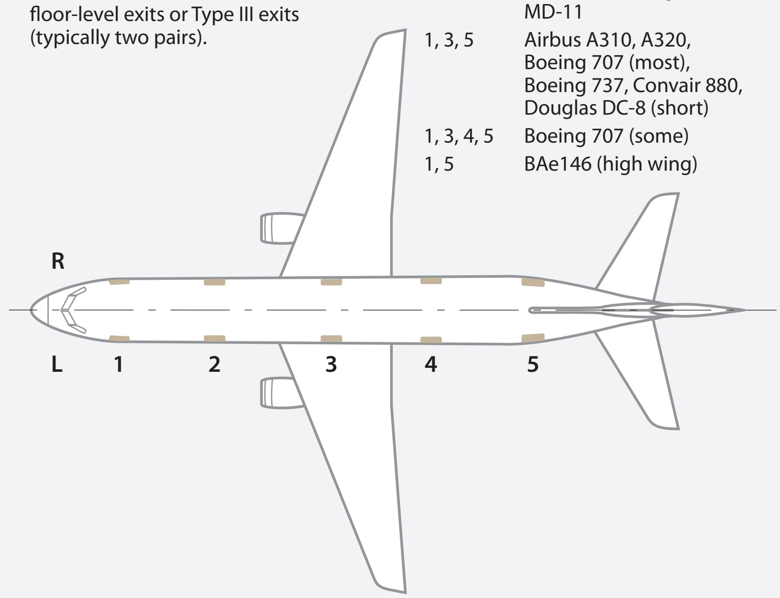
Exit locations

Locations 1, 2, 4 and 5 consist of floor-level exits.

Location 3 consists of floor-level exits or Type III exits (typically two pairs).

Examples

1, 2, 3, 4, 5	Boeing 747, DC-8-60
1, 2, 4, 5	Airbus A300, A330, A340
1, 2, 3, 5	McDonnell Douglas DC-10, MD-11
1, 3, 5	Airbus A310, A320, Boeing 707 (most), Boeing 737, Convair 880, Douglas DC-8 (short)
1, 3, 4, 5	Boeing 707 (some)
1, 5	BAe146 (high wing)



Source: Fons Schaefers

Figure 2

Numbering of Exits, Fuselage-Mounted Engine Aircraft

Exit locations

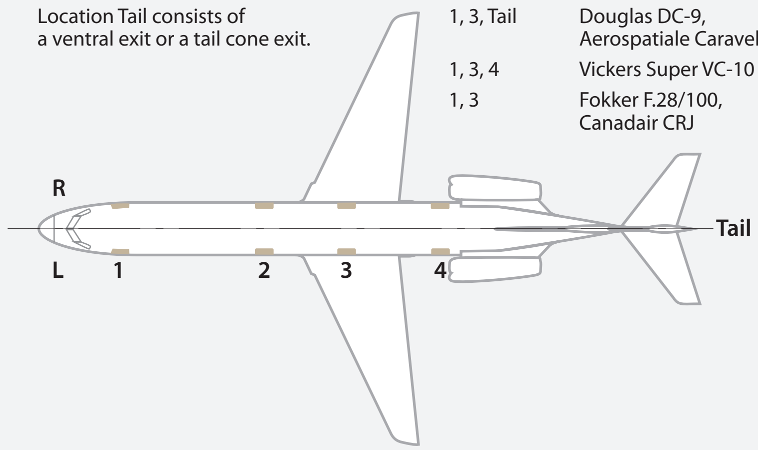
Locations 1, 2 and 4 consist of floor-level exits.

Location 3 consists of Type III exits (typically two pairs).

Location Tail consists of a ventral exit or a tail cone exit.

Examples

1, 3, 4, Tail	Boeing 727-200
1, 3, 4L, Tail	McDonnell Douglas MD-80/90
1L, 2R, 3, Tail	Boeing 727-100
1, 3, Tail	Douglas DC-9, Aerospatiale Caravelle
1, 3, 4	Vickers Super VC-10
1, 3	Fokker F.28/100, Canadair CRJ



Source: Fons Schaefers

Figure 3

a "high fatality rate," Schaefers said. "Only forward [location 1] and overwing [location 3] exits were used."

Scenario 4: Water — Intact

Ten of the accidents were included in this category, and the exit usage rate was relatively high at 70 to 100 percent for all exits other than the tail.

Scenario 5: Land — Breaks — External Fire

This is the first scenario in which the fuselage broke into two or more sections, providing additional exit possibilities beyond the standard exits — in some cases occupants were ejected or extricated by rescue personnel through the breaks.

It was a relatively common scenario, comprising 40 accidents of the 150 in the database.

"In absolute numbers, position three scored highest in scenario 5," Schaefers said. "However, although not that many aircraft have exits in positions 2 and 5, position 2 actually had the highest 'usage rate' of about 65 percent, position 5 had a rate of about 45 percent and the rest were lower."

Scenario 6: Water — Breaks

In this scenario, also one in which the fuselage breaks up, the overwing exits — position 3 — had a high percentage of use. Position 2 was also used often. The other positions scored low.

Scenario 7: Land — Intact or Breaks Unknown — External Fire

This scenario accounted for the third highest number of accidents, 32. In 29 of those, however, the exit usage was unknown, thereby limiting analysis.

Two other scenarios included 8, "Ground Collision — External Fire" and 9, "[Fuselage] Inverted," both rare enough to preclude significant findings about exit usage.

Besides the overall finding that an average of half the available exits were used, Schaefers reported that in six cases where exits were usable, no evacuation took place or only fuselage breaks were used for escape. In the greatest number of accidents, more than one but fewer than half the available exits were used (Figure 4).

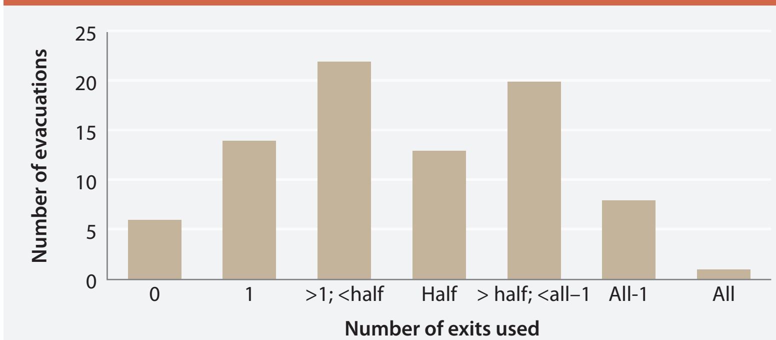
Tail exits are only used on older aircraft types. Of 27 evacuations of aircraft equipped with a tail exit, that exit was only once used successfully. "In most cases, it was not used, but in two cases, passengers and crew became trapped and had to be extricated by rescue personnel," Schaefers said. "This was not always successful and people have died as a result."

Subdividing the entire 1961–2010 period into decades, it was found that the numbers of evacuation accidents rose in 1971 through 1980, but then decreased and were lowest in the most recent decade — in spite of considerable traffic growth over the whole stretch.

In the survival ratio, or percentage of occupants who survived the accidents, there was little change from decade to decade, more than 70 percent except in 1971–1980.

Most aircraft have the same number of exits on the left and right sides. Did passengers show a bias toward evacuating via the left side, from which they had boarded? It would appear so. In the 51 cases where the data for evacuees per exit were known, 1,847 were directed to or chose

Number of Exits Used in Evacuations



Note: Data refer to evacuations (N = 90) in which the number of evacuees per exit or only the number of exits used were known, and include aircraft with wing-mounted and fuselage-mounted engines.

Source: Fons Schaefers

Figure 4

exits on the left, compared with 1,555 who used exits on the right.

The presence of fire might have influenced the side chosen for evacuation in some cases. However, in 63 cases involving external fire, there were 13 — 21 percent — in which exits on only one side were used. In only three cases were all the exits on one side used to the exclusion of the other side.

Positions 2, 3 and 5 had high evacuee rates per used exit (Figure 5). Position 1 had a high usage rate when the fuselage remained intact, but it was rarely used in break-up cases. Positions 4 and the tail were virtually unused. "Tail exits have become deathtraps," Schaefers said, recommending that they not be included in designs.

Schaefers's analysis included reasons for particular exits not being used. In approximate order of frequency, he said, they included these:

- There was a fire outside.
- The exit was in a destroyed section of the aircraft.
- The door was jammed.
- The exit was obstructed, inside or outside the aircraft.
- The aircraft's position on the ground or water made the exit unusable.
- Passengers did not understand the use of exits, particularly overwing and tail exits.

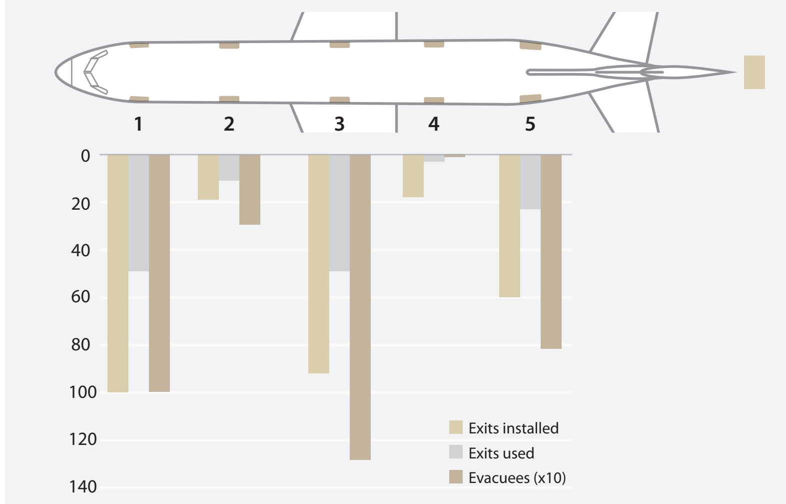
Less frequent factors included exits that were out of reach because of a fuselage break, the difficulty or impossibility of opening and then closing an exit, inward door movement impeded by crowding, slide malfunctions and submersion in water.

To sum up, Schaefers said that generally, exit use depends on the accident scenario. "In light impact cases with external fire and all cases of internal fire, forward exits are most 'popular,'" he said. "Where there has been a heavy impact, rear exits are most often used, sometimes supplemented by breaks. In water scenarios, overwing exits are most used."

His recommendations included the following:

- "Exits should be installed in opposite pairs;
- "Exits should be designed so that they can quickly be closed again after opening; [and,]
- "Do not assume exits are not usable on one side because a fire is reported on that side."

Evacuations, by Exit Positions



Note: Data refer to evacuations (N = 51) in which the number of evacuees per exit was known, and include aircraft with wing-mounted and fuselage-mounted engines.

Source: Fons Schaefers

Figure 5

Notes

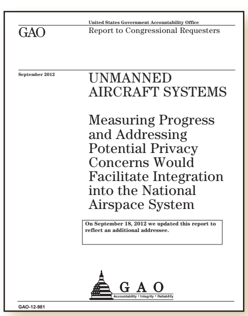
1. Schaefers, Fons. "Exit Usage in Survivable Accidents Under Life-Threatening Conditions." Proceedings of the International Cabin Safety Conference, 23–25 October 2012." Portland, Oregon, U.S.: $(L/D)_{max}$ Aviation Safety Group.
2. Criteria for inclusion of accidents in the study included the following: jet air transport aircraft; Western-designed; passengers aboard; at least one usable exit; evacuation vital (in hindsight) for life saving; not caused by hostile action. "Evacuations that were precautionary or could be determined retrospectively to have involved no threat to life were excluded," Schaefers said.

UAS Introduction: Ready . . . or Not?

FAA addresses complex issues to integrate unmanned aircraft into the national airspace system.

BY RICK DARBY

REPORTS


United States Government Accountability Office
GAO
Report to Congressional Requesters

September 2012

UNMANNED AIRCRAFT SYSTEMS

Measuring Progress and Addressing Potential Privacy Concerns Would Facilitate Integration into the National Airspace System

On September 18, 2012 we updated this report to reflect an additional addressee.

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GAO-12-981

Rulemaking Under Pressure

Unmanned Aircraft Systems: Measuring Progress and Addressing Potential Privacy Concerns Would Facilitate Integration Into the National Airspace System

U.S. Government Accountability Office (GAO), Report to Congressional Requesters. GAO-12-981. Sept. 18, 2012. <www.gao.gov/products/GAO-12-981>.

In 2012, the U.S. Congress enacted requirements and deadlines for the U.S. Federal Aviation Administration (FAA) to safely accelerate the routine operation of unmanned aircraft systems (UAS) with existing air traffic in national airspace. Most of the requirements are to be met by the end of 2015.

The GAO is watching FAA's progress, but according to this study report, FAA is not monitoring its own progress well enough.

"FAA, in coordination with stakeholders, has begun making progress toward completing those requirements, but has missed one deadline and could miss others," the report says. "Many of the requirements entail significant work, including completing planning efforts and issuing a final rule for small UAS. … While FAA has taken steps to meet them, it is uncertain when the national airspace system will be prepared to accommodate UAS, given that these efforts are occurring simultaneously and without monitoring to assess the quality of progress over time toward the deadlines Congress established."

Although the U.S. market for UAS is currently dominated by the military and government agencies, the report says that an industry forecast predicts the emergence of extensive civilian and commercial uses. These include "pipeline, utility and farm fence inspections; vehicular traffic monitoring; real-estate and construction-site photography; relaying telecommunication signals; fishery protection and monitoring; and crop dusting. FAA's goal is to eventually permit, to the greatest extent possible, routine UAS operations in the national airspace system while ensuring safety," the report says. "As the list of potential uses for UAS grows, so do the concerns about how they might affect existing military and non-military aviation, as well as concerns about how they might be used."

Currently, FAA authorizes use of UAS on a case-by-case basis, mainly to government organizations through a process called granting a certificate of waiver or authorization (COA), and to some private sector operators for experimental purposes via special airworthiness certificates. As the UAS fleet and number of operators grows, FAA will be faced with merging the unmanned aircraft into airspace that averages 100,000 flights a day, including commercial air carriers, general aviation and military aircraft.

"In 2008, we reported that UAS could not meet the aviation safety requirements developed for manned aircraft and that UAS posed several obstacles to operating safely and routinely in the national airspace system," the report says. "FAA and others have continued their efforts to address these obstacles, but many still remain, including:

- "The inability for UAS to detect, sense and avoid other aircraft and airborne objects in a manner similar to 'see and avoid' by a pilot in a manned aircraft [for recent developments concerning this issue, see 'Pressure Gradient,' *ASW*, 10/12, p. 16];
- "Vulnerabilities in the command and control of UAS operations;
- "The limited human factors engineering incorporated into UAS technologies;
- "Unreliable UAS performance;
- "The lack of technological and operational standards needed to guide the safe and consistent performance of UAS;
- "The lack of final regulations to guide the safe integration of UAS into the national airspace system; [and,]
- "The transition to NextGen [the Next Generation Air Transportation System]." NextGen is a comprehensive overhaul of the U.S. National Airspace System (NAS) to add capabilities that make air transportation safer and more reliable, increase the air traffic capacity of the NAS, and reduce the impact of aviation on the environment, FAA says.

FAA has undertaken several initiatives for safely folding UAS into the NAS. They fall into four broad categories.

The first is a comprehensive plan and road map. This includes a phased-in approach to, and timeline for, the integration and the establishment of a process to develop certification, flight standards and air traffic requirements at UAS test ranges.

"To date, FAA has not developed measures for assessing the various efforts to achieve safe integration by September 2015," the report says. "The 2012 act [detailing FAA's requirements for UAS integration] specifies content for a more comprehensive plan than what was laid out in the two-page road map, but it does not set forth any expectation for monitoring to assess the quality of progress over time toward meeting the range of activities to be outlined in the plan.

"Our [GAO's] *Standards for Internal Control in the Federal Government* provide the overall framework for establishing and maintaining internal control and for identifying and addressing major performance and management challenges and areas at greatest risk of fraud, waste, abuse and mismanagement. One of those standards is monitoring, which is an internal control designed to assess the quality of performance over time. This internal control should generally be designed to assure that ongoing monitoring occurs in the course of normal operations and that it is performed continually and is ingrained in the agency's operations. In light of the time frames and complicated tasks ahead, the absence of regular monitoring precludes the agency and Congress from assessing progress toward completion of the 2012 act requirements."

The second category involves the COA process. The report says, "FAA has changed the existing COA process … including taking steps to expedite COAs for public safety entities and finalizing agreements with government agencies to expedite the COA or waiver process."

FAA will be faced with merging the unmanned aircraft into airspace that averages 100,000 flights a day.

Among other types of streamlining, the length of UAS authorization has been extended from 12 months to 24 months, so users do not have to reapply as frequently.

Third, "FAA has taken steps to develop, but has not yet established, a program to integrate UAS at six test ranges, as required by the 2012 act. … FAA expects data obtained from these test ranges will contribute to the continued development of standards for the safe and routine integration of UAS."

FAA's request for comments about test ranges, published in the *Federal Register*, drew 227 responses from Congress, state and local governments, industry, academia and individuals. The agency now finds itself with a collection of varied, if not conflicting, suggestions. "The comments addressed questions such as what certification requirements should be set for aircraft as part of the test ranges, who should manage the airspace and what restrictions should be placed on those using the test ranges, and where test ranges should be located," the report says. "For example, FAA has proposed outsourcing the management of the test ranges; however, some commenters preferred FAA or another public entity to maintain oversight responsibility. Some commenters also said that test ranges should be selected based on locations with existing facilities and infrastructure, given the absence of any funding available for the set-up, management or oversight of the test ranges."

The agency now finds itself with a collection of varied, if not conflicting, suggestions.

The fourth category falls under the head of rulemaking. "While FAA has efforts under way supporting a rulemaking for small UAS, as required by the 2012 act, it is uncertain whether FAA will be able to meet the established deadline," the report says.

The report says that, although FAA has made progress toward meeting the requirements of the 2012 act, "those requirements that remain will require significant work from the agency to meet the established deadlines. FAA has reorganized to provide more focus on its UAS integration efforts; however, because the reorganization has not yet been fully implemented, it remains unclear whether it will provide the support needed to complete the work.

"FAA's UAS efforts rely on expertise and resources from several offices within FAA, such as the Aviation Safety Organization, the Air Traffic Organization, the Research and Development Integration Office, the NextGen Office and the federal multi-agency Joint Planning and Development Office. FAA has reorganized its office that oversees UAS activities several times over the past few years but had not previously assigned a single and visible leader to this effort. We have previously reported the need for stable leadership at FAA for major aviation efforts. More recently, FAA has taken steps to provide the organizational leadership needed to facilitate progress to safely accelerate UAS integration into the national airspace system.

"In March 2012, FAA assigned an executive manager for its newly created UAS Integration Office, which is expected to combine UAS-related activities from the agency's Air Traffic Organization and Aviation Safety Organization. However, as of July 2012, the UAS Integration Office had not yet been finalized within FAA and no employees had been officially assigned to the UAS Integration Office. FAA officials told us that they expect approximately 50 federal employees and contractors eventually will be assigned to the office; however, the officials are still evaluating the number of personnel needed."

The report discusses other privacy and security issues that might further delay the acceptance of UAS in FAA's domain.

UAS are potentially capable of providing some kinds of surveillance data at far less cost than "spy" satellites. "Recently, members of Congress, a civil liberties organization and others expressed concern that the potential increased use of small UAS for surveillance and other purposes in the national airspace system has potential privacy implications," the report says. "Many stakeholders we interviewed projected how past Supreme Court cases that address privacy issues related to government surveillance might apply to UAS. While the Supreme Court has not addressed privacy issues related to governmental UAS surveillance, the court has, however, upheld several instances involving government aerial surveillance from manned aircraft."

The U.S. Transportation Security Administration (TSA) is charged with addressing risks, threats and vulnerabilities in transportation — including non-military UAS. "According to a TSA official, it recently reviewed its UAS-related advisories and determined that they are still applicable," the report says. "However, TSA has not provided information on specific steps it has taken to mitigate the potential threats but believes its current practices are sufficient to address UAS security. …

"Security remains a significant issue that could be exacerbated with an increase in the number of UAS. TSA's practices might be sufficient in the current UAS environment of limited operations taking place under closely controlled conditions, but these controlled conditions will change as FAA and others continue to work toward allowing routine UAS operations in the national airspace system. Without an assessment of TSA's current security practices, TSA is not equipped to know whether any changes to its practices are needed. … For example, TSA has not yet taken steps to develop security requirements for UAS ground control stations, which are the UAS equivalent of cockpits."

Another perceived threat is the possible jamming of the global positioning system (GPS) broadcasts that enable the UAS pilot or autonomous piloting systems to navigate. The report says, "In a GPS jamming scenario, the UAS could potentially lose its ability to determine its location, altitude and the direction in which it is traveling. Low-cost devices that jam GPS signals are prevalent. According to one industry expert, GPS jamming would become a larger problem if GPS is the only method for navigating a UAS. This problem can be mitigated by having a second or redundant navigation system onboard the UAS that is not reliant on GPS, which is the case with larger UAS typically operated by [the Department of Defense] and [the Department of Homeland Security]."

In its conclusions, the report says, "FAA faces the daunting task of ensuring that all of the various efforts within its own agency, as well as across agencies and other entities, will align and converge in a timely fashion. The pace of progress toward UAS integration that occurred prior to the 2012 act and questions about the agency's ability to meet deadline requirements raise concerns about when UAS integration in the national airspace system will be achieved. Incorporating regular monitoring will help to assess progress toward goals identified in the comprehensive plan and five-year road map that can help FAA understand what has been achieved and what remains to be done."

WEBSITES

New Online Safety Support

Global Aerospace SM4, <SM4.global-aero.com>

Global Aerospace, a provider of aerospace insurance and services, has launched a website centered around its SM4 safety programs and newsletter.

The site includes a library of aviation safety topics searchable by keyword, topic or author; the SM4 Safety Blog, the goal of which is "to create cutting-edge conversations about the most important topics in aviation safety and risk management"; current and past editions of the monthly *SM4 Safety Newsletter*; and "support tools and information" from the company's partners — Baldwin Aviation, Convergent Performance, Fireside Partners, ICF SH&E and MedAire.

Close Call Over the Atlantic

An air traffic control breakdown placed an airliner and a military transport on a collision course.

BY MARK LACAGNINA

The following information provides an awareness of problems that might be avoided in the future. The information is based on final reports by official investigative authorities on aircraft accidents and incidents.

JETS

Message Misunderstood

Boeing 777-200, Boeing C-17 Globemaster. No damage. No injuries.

Incomplete and incorrect coordination among air traffic controllers was cited by the U.S. National Transportation Safety Board (NTSB) as the probable cause of a near midair collision between the 777 and the C-17 over the North Atlantic the night of Jan. 20, 2011.

In its final report on the incident, the NTSB said that noncompliance with established communications phraseology and incorrect data block displays were contributing factors when the airliner and the lead airplane in the flight of two U.S. Air Force C-17 transports came within 0.38 nm (0.70 km) of each other at the same altitude about 80 nm (148 km) southeast of New York.

The incident occurred at 2235 local time in visual meteorological conditions (VMC) on what was described as a dark night. The 777 was southeast-bound, en route from New York's John F. Kennedy International Airport on a scheduled passenger flight to São Paulo, Brazil. The C-17s were west-bound, returning to Joint Base McGuire-Dix-Lakehurst in Wrightstown, New Jersey, after completing an aerial-refueling operation with a McDonnell Douglas KC-10. The lead C-17 was about 4,000 ft (1,219 m) ahead of the other transport and about 500 ft (152 m) left.

The airplanes were in the same sector of airspace governed by the New York Air Route Traffic Control Center but were being handled by two different radar controllers. One controller had cleared the 777 flight crew to climb to Flight Level (FL) 230 (approximately 23,000 ft); the other controller had cleared the lead C-17 flight crew to descend from FL 250 to 10,000 ft.

The controller handling the 777 was engaged in clarifying a route clearance with the crew of another airplane in the sector when he received a landline call from the center's air traffic data controller, who was coordinating the activities of both the 777 controller and the C-17 controller. The 777 controller, focusing on a lengthy clearance readback by the other crew, told the coordinator that he would call back, but the coordinator proceeded to instruct the controller to stop the 777's climb at FL 210. The 777 controller apparently did not hear that instruction.

"While still on an open line with that controller, the data controller [coordinator] leaned toward the controller working the two C-17s and told him to stop his flight at FL 220," the report said. "The controller working the 777 overheard the portion of the communication where the [coordinator] said to stop at FL 220 and believed that the instruction was meant for the 777. Therefore, the controller instructed the 777 to climb to FL 220, while at the same time the [other] controller instructed the C-17s to descend to FL 220."

New York Center's radar data processing system generated a conflict alert about the same time the 777 crew received a traffic-alert and collision avoidance system (TCAS) resolution advisory to descend. The airplanes were about 7 nm (13 km) apart when the 777 crew reported that they were following a TCAS "descend" instruction. The report noted that the initial TCAS resolution advisory to descend was soon followed by an advisory to increase the descent rate and then by an advisory to climb, but the report did not provide details about the reversal or the crew's response to the TCAS resolution advisories.

The C-17s also were equipped with TCAS, but the systems were configured to provide only traffic advisories.

"When the controllers noticed the conflict, they instructed both [the 777] and [the C-17s] to turn, in an unsuccessful attempt to maintain separation," the report said. The 777 crew was instructed to turn left, and the C-17 crews were told to turn right.

The 777 crew also was advised that they had "traffic now one o'clock, four miles southwest, heavy C-17, Flight Level 220." A few seconds later, the controller asked the 777 crew if they had the traffic in sight. The response was: "No, we do not."

The crew of the lead C-17 was advised that the "traffic right below you is a Boeing triple-seven that should be leveling at Flight Level 210." The C-17 crew replied, "Yeah, [we] just came within approximately 2,000 feet of that traffic."

The 777 crew then radioed, "That guy passed us now, and that was not good." The controller replied, "I understand that, and I apologize. I am not working that other airplane."

Investigators found that when the near collision occurred, the data blocks on the controllers' radar displays did not show the actual altitude assignments — that is, that the 777 and the C-17s had been cleared to FL 220. Instead, "the data block for the 777 indicated that the airplane was cleared to climb to FL 230, and the data block for the C-17s indicated that [they] were cleared to descend to 10,000 ft," the report said. "Both of these were incorrect."

Tail Strike During Go-Around

Airbus A321-211. Minor damage. No injuries.

The A321 was en route the evening of Dec. 23, 2011, from Austria with 182 passengers and six crewmembers to Manchester, England, which was reporting surface winds from 320 degrees at 16 to 27 kt, scattered clouds and light rain showers. The aircraft encountered turbulence as it descended through 1,500 ft above ground level (AGL) during the instrument landing system (ILS) approach to Manchester's Runway 23R.

"The copilot [the pilot flying] disengaged the autothrust system as briefed, and, with turbulence increasing as the aircraft descended, the commander increased the approach speed target by 5 kt," said the report by the U.K. Air Accidents Investigation Branch (AAIB). "Slightly below 1,000 ft, the copilot disengaged the autopilot."

Aircraft control became increasingly difficult as the A321 descended below 400 ft, and the copilot had to make nearly continuous roll inputs, occasionally with full sidestick deflection. "By about 100 ft, the situation had become worse, and shortly afterwards, he initiated a go-around," the report said, noting that recorded flight data showed a wind shear from a 4-kt tailwind component to an 8-kt headwind component.

The crew set TOGA (takeoff/go-around) thrust, and the copilot rotated the aircraft to a 10-degree nose-up pitch attitude. "Almost simultaneously, the crew sensed a severe downdraft which caused the aircraft to sink and the main gear to make contact with the runway," the report said. Flight data showed that the 8-kt headwind component had sheared to an 8-kt tailwind component as the go-around was initiated.

The crew completed the go-around and then added 10 kt to the target airspeed for the second approach. The aircraft again encountered wind shear, which caused a 10- to 15-kt airspeed loss close to the runway, but the copilot landed the Airbus without further incident.

"During the commander's external inspection after arriving on stand, he discovered

The data blocks on the controllers' radar displays did not show the actual altitude assignments.

damage to the lower rear fuselage skin and suspected that the aircraft had suffered a tail strike during the go-around manoeuvre," the report said. "An engineering inspection confirmed that the aircraft would be unable to operate the return sector pending further maintenance action."

Asleep at the Wheel

Boeing 737-700. Substantial damage. No injuries.

A snowplow operator was clearing snow from the ramp at Denver International Airport the afternoon of Dec. 22, 2011. He had been on duty for 6.5 hours after a six-hour rest break, during which he attempted to sleep in a vehicle following a previous shift from 1730 to 0200 local time. Investigators were unable to determine why he spent the rest period in the vehicle, rather than in the snow-removal company's bunkhouse.

As the 737 accelerated through 80 kt, the commander saw the A321 taxiing toward the end of the runway.

"Since the vehicle was being operated, he probably did not get uninterrupted sleep and, most likely, got less than six hours of sleep," the NTSB report said. "The company did not have, and was not required to have, guidance or a policy addressing fatigue management."

The snowplow operator told investigators that he fell asleep while driving behind the 737, which was being prepared for pushback from the gate. "The snowplow passed the airplane and then initiated a gradual turn to the right," the report said. "The snowplow continued around 180 degrees and hit the airplane on the left side, near the empennage."

The impact buckled the auxiliary power unit access door, pierced three 4-in (10-cm) holes in the fuselage skin and broke a stringer. The snowplow cabin also was damaged, but the operator was not hurt.

The report said that the snow-removal company's "lack of a policy regarding employee fatigue" was a factor in the accident. The company told investigators that its snowplow operators typically worked 12- to 14-hour shifts and that "the responsibility for fatigue and fatigue management comes down to personal responsibility."

Incursion Prompts High-Speed RTO

Airbus A321-231, Boeing 737-800. No damage. No injuries.

Runway 16 was in use at Dublin (Ireland) Airport the afternoon of May 21, 2011, but the A321 flight crew requested, and received, clearance to use the longer runway, Runway 28, for departure. The Airbus was bound for Tenerife, Spain, with 152 passengers and six crewmembers.

As the A321 was taxied from the stand, the ground traffic controller instructed the crew to proceed via Taxiway E1 and hold short of Runway 28. Taxiway E1 leads to an intersection common to the approach end of Runway 28 and the departure end of Runway 16. Although a left turn and a right turn were required to reach the taxiway, the crew mistakenly continued taxiing straight ahead, onto Taxiway A, which is northwest of Taxiway E1.

Meanwhile, the ground controller had instructed the A321 crew to switch to the tower frequency and had diverted her attention to other aircraft. She did not see the A321 enter Taxiway A.

"As they approached the edge of Runway 16, the first officer, or pilot not flying (PNF) questioned their position, so [the commander] stopped the aircraft," said the report by the Irish Air Accident Investigation Unit. The A321 came to a stop on the runway.

By this time, the tower controller had cleared the flight crew of the 737 to take off on Runway 16. The 737 was bound for Vilnius, Russia, with 145 passengers and six crewmembers. The crew initiated the takeoff as the A321 was taxied onto Taxiway A.

As the 737 accelerated through 80 kt, the commander saw the A321 taxiing toward the end of the runway, and she asked the first officer, "Where's that guy going?" The first officer replied, "He's taxiing out in front of us." The commander called "stop" and initiated a high-speed rejected takeoff (RTO) just before the tower controller instructed the crew to discontinue the takeoff.

Indicated airspeed was 123 kt, or about 4 kt below V_1, and the 737 was 820 m (2,690 ft) from the approach end of Runway 16, when the

737 commander applied the wheel brakes and reduced power to initiate the RTO. The Boeing came to a stop about 360 m (1,181 ft) from the Airbus, or about 1,455 m (4,774 ft) from the approach threshold of Runway 16. The 737 crew then taxied the aircraft back to the stand, where maintenance technicians examined the wheel brakes and released the aircraft for departure.

"When asked by investigators if she had carried out an actual RTO before, the [737] commander said she had not and added that 'all the simulator training works,'" the report said.

The A321 pilots told investigators that the taxi route from the stand to the runway was short but complicated, and that bright sunlight reflecting off the wet taxiways had made the yellow markings difficult to see.

The report noted that a red stop bar on Taxiway A was used only during low-visibility conditions and, thus, was not illuminated when the incident occurred. Dublin Airport Authority made several changes as the result of the incident, including mandating 24-hour use of the stop bar, installing additional taxiway directional markings and publishing "hot-spot" information on the airport chart.

Braking Action Deteriorates

Gulfstream G200. No damage. No injuries.

The airplane's departure from Bozeman, Montana, U.S., for a positioning flight to Jackson, Wyoming, the morning of Nov. 22, 2010, was delayed because of adverse weather conditions and reported runway surface friction (MU) values in the 20s at Jackson Hole Airport.

"MU values range from 0 [to] 100, where 0 is the lowest friction value and 100 is the maximum friction value," the NTSB report said. "A MU value of 40 or less is the level at which aircraft braking performance starts to deteriorate and directional control begins to be less responsive."

About an hour after the originally planned departure time, a company dispatcher released the G200 for the flight, telling the flight crew that the weather at Jackson had improved and that MU values were in the 40s.

The airplane was about 10 minutes from the destination when air traffic control (ATC) told the crew that the reported MU values on the beginning, middle and end of Runway 19 were 40, 42 and 40, respectively, with patchy thin snow over patchy thin packed snow and ice on the runway surface.

The crew conducted the ILS approach to Runway 19 in weather conditions that included surface winds from 180 degrees at 11 kt, 1/2 mi (800 m) visibility in light blowing snow, a broken ceiling at 500 ft and an overcast at 2,500 ft.

"The landing was made at a time when the runway conditions were deteriorating and the braking performance was becoming less effective," the report said. "During the landing roll, thrust reversers were deployed, and the crew noted that all of the ground and air slat indication lights were green and that the anti-skid system began to pulse. … Despite the application of maximum thrust reverse, there was no effect on slowing the airplane, and it exited the departure end of the 6,300-ft [1,920-m] runway and came to rest just beyond the blast pad."

The report noted that MU values were reported as 34, 33 and 23 about seven minutes after the G200's overrun.

TURBOPROPS

Jammed Door Blocks Gear

Fairchild Dornier SA 227-DC. Minor damage. No injuries.

Night VMC prevailed on Jan. 19, 2010, when the Metroliner, inbound from Brno, Czech Republic, with just the two pilots aboard, was established on final approach to Runway 07 at Stuttgart (Germany) Airport. When the crew attempted to extend the landing gear, they received an indication that the right main landing gear was not down and locked.

After cycling the landing gear and receiving the same indication, the crew initiated a go-around and tried several times to extend the landing gear using the emergency procedure. "All attempts were futile," said the report by the German Federal Bureau of Aircraft Accident

Investigation (BFU). "The indications for the right main landing gear remained red."

The crew flew the Metroliner past the airport traffic control tower for a visual check by the controllers, who confirmed that the right main landing gear was not extended. The crew then was vectored to an area where they induced positive and negative loads on the aircraft in an attempt to unlock the right main gear. "After nine minutes, the attempts were aborted because they had been in vain," the report said. "The crew declared an emergency and decided to land with the one remaining main landing gear and the nose landing gear."

Both engines were shut down, the propellers were feathered, and the electrical system was disengaged before the aircraft touched down. "After the landing, as speed had been reduced and the right wing could no longer be kept in the air, the aircraft was steered toward the right and off the runway into the grass, so that the right wing could be rested on soft ground," the report said. "After the aircraft had come to a complete stop, the crew left it by way of the passenger door."

Investigators found that the outer clamshell door on the right main landing gear had jammed against the edge of the wheel well and had prevented the gear from extending. Pre-existing dents and rippling of the door skin were found, but the cause of this damage was not determined.

Fuel Planning Falls Short

Cessna 208 Caravan. Substantial damage. One minor injury.

The Caravan was refueled with 16 gal (61 L) of jet fuel, which the pilot deemed sufficient for two skydiving flights near Mesquite, Nevada, U.S., on Dec. 17, 2011. "During the second skydiving flight, he delayed releasing the skydivers due to traffic in the area," the NTSB report said. "As he turned the airplane back toward the drop zone, the airplane's engine experienced a total loss of power."

The pilot signaled the skydivers to jump and attempted to land the powerless airplane on the runway. The Caravan touched down long, overran the runway and crossed a road before coming to a stop on a golf course.

The report said that the probable cause of the accident was "the pilot's improper preflight planning, which resulted in a loss of engine power due to fuel exhaustion."

Asymmetric Reverse Thrust

Dornier 328-100. Minor damage. No injuries.

Two pilots and three technical crewmembers were dispatched from Cairns, Queensland, Australia, to participate in a search-and-rescue mission at Horn Island the afternoon of Jan. 10, 2012. While conducting an NDB (nondirectional beacon) approach, the crew noted that they would have an 8-kt left crosswind on landing.

Shortly after touching down on the runway centerline, the first officer, the pilot flying, moved the power levers into ground idle, then into reverse. "The flight data recorder indicated that the reverse thrust was initially applied evenly," said the report by the Australian Transport Safety Bureau.

However, when the first officer released back pressure on the power levers as the aircraft decelerated through 48 kt, the reduction of internal spring pressure moved the right lever into ground idle, but the left power lever remained in the reverse position. The resulting asymmetric thrust caused the Dornier to veer left, despite the first officer's application of full right rudder.

The first officer transferred control to the captain shortly before the aircraft veered off the left side of the runway.

"At the same time, the nosewheel weight-on-wheels sensor showed the nosewheel alternating between ground and air modes, resulting in the nosewheel steering not being operational," the report said.

The first officer transferred control to the captain shortly before the aircraft veered off the left side of the runway. "The captain brought both power levers back into reverse thrust and recovered the aircraft back onto the runway," the report said. "Following the incident, an engineering inspection found that the left power lever appeared not to spring as far forward as the right power lever when released from the reverse thrust position.

"Power lever split had been noted on other aircraft within the fleet; however, the operator did not consider that these presented a serviceability issue as the approved technique for bringing the power levers out of reverse thrust back to ground idle required a controlled input and not reliance on the release of spring tension alone."

Loose Bolt Causes Gear Collapse

Mitsubishi MU-2B-20. Minor damage. No injuries.

The pilot heard a "pop" when he extended the landing gear on approach to Walterboro, South Carolina, U.S., the afternoon of Jan. 16, 2011. "During the landing roll, the nose gear collapsed, resulting in minor damage to the nose gear doors and the skin behind the nose gear area," the NTSB report said. The pilot and his passenger were not hurt.

Examination of the MU-2 revealed that the bolt holding the downlock drag brace joint link to the airframe was loose and had fractured when the nose gear was extended. The report said that the nose gear rigging had not been adequately checked, as required, during the last maintenance inspection of the airplane.

PISTON AIRPLANES

Mountain Shrouded by Clouds

Piper Navajo. Destroyed. Two fatalities.

Having recently retired from airline operations, the pilot departed from Welshpool (Wales, U.K.) Airport the morning of Jan. 18, 2012, to refamiliarize himself with the Navajo in preparation to fly part-time in business operations. VMC prevailed at the airport, but low broken clouds shrouded the tops of local mountains.

Another pilot familiar with the aircraft and the area accompanied the pilot. They initially flew south for some distance and then returned to land. The pilot flew over the runway, established the aircraft on upwind, crosswind and then left downwind for Runway 22. He flew a wider-than-normal downwind leg, likely to provide clearance from a helicopter ahead on downwind, said the AAIB report.

The report said that the pilots might have thought they were clear of high terrain north of the airport when they began a wide left base and inadvertently descended into clouds. The Navajo struck the tops of trees and crashed in a field on the upper slope of a mountain about 2 nm (4 km) northeast of the airport.

Takeoff on an Empty Tank

Cessna U206G. Substantial damage. One serious injury, three minor injuries.

The single-engine airplane was departing from Matinicus Island, Maine, U.S., for a charter flight to Rockland the afternoon of July 17, 2011, when the engine began to lose power about 200 ft above the ocean. The pilot "immediately advanced the throttle and turned on the auxiliary fuel pump, with no results," the NTSB report said.

The airplane sank after it was ditched, but the pilot and his three passengers, one of whom was seriously injured on impact, clung to the separated cargo pod for about one hour until they were rescued by the crew of a fishing boat.

The passengers had not received a preflight briefing. "If a piece of wreckage had not been available for the passengers to hold on to, the failure of the pilot to notify the passengers of the availability of life vests could have increased the severity of the accident," the report said.

Examination of the recovered wreckage showed that the fuel selector was positioned to the right tank, which held about 1 pint (1/4 L) of fuel and 25 gal (95 L) of seawater. The left tank held about 27 gal (102 L) of fuel and 2 gal (8 L) of seawater. The report said that the probable cause of the accident was "the pilot's improper fuel management, which resulted in a total loss of engine power due to fuel starvation."

Pressing Ahead in IMC

Piper Twin Comanche. Destroyed. Two fatalities.

The pilot had filed a composite visual/instrument flight rules flight plan from Lucques, Italy, to Troyes, France, but, en route at 2,000 ft the morning of June 17, 2011, he asked a controller at Nice Flight Information Service if he could transition to instrument flight rules earlier than planned. "The controller responded that it was not possible to comply with this request," said the report by the French Bureau d'Enquêtes et d'Analyses (BEA).

The controller then asked the pilot to navigate via two waypoints that took the Twin Comanche north of the flight-planned route. The pilot complied with the request while continuing under visual flight rules (VFR).

The aircraft was registered in England, and U.K. representatives who participated in the investigation commented that the controller's request did not comply with standard ATC phraseology and might have been interpreted by the pilot as an instrument flight rules clearance.

About eight minutes after making the request, the controller told the pilot that he had lost radar contact with the aircraft. The pilot acknowledged the advisory about two minutes before the Twin Comanche struck rising terrain at 2,700 ft, killing the pilot and his passenger.

The BEA report concluded that "the accident was due to the pilot's decision to continue the flight under VFR in instrument meteorological conditions [IMC] and at an altitude that was lower than the high ground in the region."

HELICOPTERS

Ice Ingestion Causes Flameout

MD Helicopters MD-600N. Destroyed. Two serious injuries, one minor injury.

The flight crew was inspecting the roofs of buildings in central Germany for snow damage and landed the helicopter on a street in Jena to board an employee of a building-supplies store the afternoon of Dec. 28, 2010. "Witnesses observed a big snow cloud being raised by the helicopter and it hovering for a long period of time above the snow cloud before it finally landed," said the BFU report.

During the subsequent lift-off, the helicopter again raised a large amount of snow and was transitioning to forward flight at about 100 ft AGL when the engine flamed out. Both pilots were seriously injured and the passenger sustained minor injuries when the MD-600 descended rapidly to the street.

The report concluded that "the accident occurred due to a sudden engine failure shortly after takeoff caused by the ingestion of ice at a height and with a speed not sufficient for autorotation."

Wire Strike Over Highway

Hughes 369D. Substantial damage. No injuries.

Before departing on a positioning flight from Knoxville, Tennessee, U.S., the afternoon of Dec. 21, 2011, the pilot determined that VMC prevailed at Knoxville and at the destination, Blountville, also in Tennessee.

"However, while the pilot was following a highway in cruise flight at 400 ft AGL, the ceiling rapidly became lower, and the pilot encountered IMC," the NTSB report said. "Moments later, while cruising at an airspeed of 65 kt, the pilot saw marker balls, which indicated that power lines were directly in front of the helicopter."

The pilot began a right, diving turn in an attempt to avoid the power lines, but a main rotor blade struck a wire. "The rotor speed remained within limits, but the helicopter began to vibrate, so the pilot decided to land in a nearby field," the report said. Examination of the helicopter revealed substantial damage to the rotor blade.

Settling With Power

Robinson R44. Destroyed. Two fatalities.

The pilot was circling at low altitude and waving at people on the ground when the R44 descended and struck terrain near Centerville, Louisiana, U.S., the morning of Jan. 19, 2012. The pilot and his passenger were killed.

"Examination of the airframe and engine revealed no evidence of mechanical malfunctions or failures that would have precluded normal operation," the NTSB report said. "Impact signatures were consistent with the engine developing power at impact, and it is likely that … the helicopter was in a steep descent consistent with settling with power."

Preliminary Reports, October–November 2012

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Oct. 7	St. John's, Antigua and Barbuda	Britten-Norman 2A-26	destroyed	3 fatal, 1 serious
Thunderstorms were reported in the area when the Islander crashed on takeoff.				
Oct. 7	Khartoum, Sudan	Antonov 12BP	destroyed	13 fatal, 9 serious
The An-12 crashed after two engines lost power on departure.				
Oct. 7	Medford, Oregon, U.S.	Garlick UH-1H	substantial	1 minor
The helicopter crashed in a valley after the tail rotor gearbox separated during a firefighting mission.				
Oct. 9	Mount Pocono, Pennsylvania, U.S.	Bell 407	destroyed	2 fatal, 1 serious
The helicopter struck terrain in instrument meteorological conditions (IMC) during a business flight from Elmira to White Plains, New York.				
Oct. 14	Antalya, Turkey	Boeing 737-800	substantial	2 serious, 25 minor, 162 none
The captain ordered an emergency evacuation after a fire erupted on the flight deck during pushback.				
Oct. 19	Nifty Copper Mine, Western Australia	Fokker 100	substantial	
The aircraft landed hard after encountering wind shear on approach.				
Oct. 19	Pontianak, Indonesia	Boeing 737-400	substantial	160 none
The nose landing gear collapsed when the 737 overran the runway while landing in heavy rain.				
Oct. 25	Yola, Nigeria	Cessna 208B	destroyed	6 NA
Night IMC prevailed when the Caravan struck trees on approach. All six occupants were injured.				
Oct. 28	Bir Kalait, Chad	Beech 1900D	destroyed	17 NA
The aircraft struck terrain short of the runway on approach. No fatalities were reported.				
Oct. 31	Boyne City, Michigan, U.S.	Piaggio P180	substantial	1 none
The Avanti veered off the runway after touchdown and struck the airport perimeter fence.				
Nov. 1	San Marcos, Texas, U.S.	Cessna 320E	destroyed	1 fatal
Visibility was 1/2 mi (800 m) in fog when the airplane crashed on takeoff.				
Nov. 3	Atlanta, Georgia, U.S.	Hughes OH-6A	destroyed	2 fatal
The police helicopter struck a power line and crashed on a road during a night search mission.				
Nov. 6	Curitiba, Brazil	Piper Cheyenne IIXL	destroyed	4 fatal
The Cheyenne crashed in a field after control was lost on approach.				
Nov. 6	Wichita, Kansas, U.S.	Cessna 208B	substantial	1 fatal
The Caravan crashed in a field on departure after the pilot reported that the windshield was covered with oil.				
Nov. 10	Shaver Lake, California, U.S.	Cessna 421C	destroyed	2 fatal
The airplane was at 27,000 ft when it entered a rapid descent and broke up in flight.				
Nov. 11	São Paulo, Brazil	Cessna 525B CJ3	destroyed	1 serious, 2 minor
The airplane overran the runway, traveled down a slope and crashed into a stone wall.				
Nov. 15	Aweil, South Sudan	Fokker 50	substantial	57 NA
The left main landing gear collapsed and the left wing separated when the Fokker overran the runway.				
Nov. 17	Greenwood, South Carolina, U.S.	Cessna 550 Citation II	destroyed	2 none
Collision with a deer on landing ruptured the left wing fuel tank. The pilots were able to exit the Citation before it was consumed by fire.				
Nov. 18	Snow Lake, Manitoba, Canada	Cessna 208B	destroyed	1 fatal, 7 serious
The pilot was killed when the Caravan struck terrain while departing in adverse weather conditions.				
Nov. 21	San'a, Yemen	Antonov 26	destroyed	10 fatal
The An-26 crashed out of control in an abandoned marketplace shortly after the flight crew reported technical problems on departure.				
Nov. 21	Deputatskiy, Russia	Antonov 26B-100	substantial	26 NA
The An-26 veered off the runway on landing and struck a snowbank.				
Nov. 27	Moroni, Comoros	Embraer 120ER	destroyed	29 NA
The flight crew ditched the Brasilia after reporting a fuel leak on departure. All the occupants were rescued.				
Nov. 30	Brazzaville, Congo	Ilyushin 76T	destroyed	32 fatal
The six crewmembers and 26 people on the ground were killed when the cargo aircraft overran a wet runway, struck several dwellings and crashed in a ravine.				

NA = not available

This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.

Selected Smoke, Fire and Fumes Events, August–September 2012

Date	Flight Phase	Airport	Classification	Subclassification	Aircraft	Operator
Aug. 1	Descent	—	Air distribution system	Smoke	Embraer EMB-135LR	American Eagle Airlines
While the aircraft was on final approach, a flight attendant reported an odor of smoke in the galley. The circuit breakers in the galley were pulled. The flight crew declared an emergency and landed the aircraft without incident. The odor source was located in the galley trash can bin, but maintenance technicians could not determine what had caused the smoke odor.						
Aug. 3	Cruise	New York (JFK)	Air distribution fan	Smoke	Embraer ERJ-190	JetBlue Airways
The flight from Washington Dulles to Boston Logan was diverted to JFK because of in-flight electrical smoke. Maintenance technicians found the odor emerging from recirculating fan vents in the cockpit. They removed and replaced the recirculating fan.						
Aug. 8	Climb	—	Cabin cooling system	Smoke	Embraer EMB-145LR	Atlantic Southeast Airlines
After takeoff, the crew reported smoke in the cabin and elected to return to the departure airport, where the aircraft was landed without incident. Upon inspection, maintenance found the source of the smoke to be a seized no. 1 air cycle machine. Maintenance replaced the air cycle machine.						
Aug. 11	Cruise	Boston (BOS)	Air distribution fan	Smoke	Boeing 767	US Airways
The crew reported two occasions of smoke and fumes: a sweet, burning smell throughout the cabin shortly after takeoff, then strong electrical smoke about one hour into flight. The crew declared an emergency and diverted into BOS. The aircraft was landed without further incident. Maintenance replaced the right recirculation fan. The vendor's repair shop findings included moderate contamination, bearings separated, bearings seized in the endbell, the rotor grooved and the endbell distorted.						
Aug. 18	Climb	—	Attitude gyro and indicating systerm	Smoke	Boeing 767	United Parcel Service
The flight was turned back due to the captain's attitude director indicator (ADI) becoming inoperative, with a popping and crackling heard, accompanied briefly by an electrical odor. Maintenance found the captain's ADI circuit breaker tripped and replaced the ADI.						
Aug. 21	Climb	—	Cabin cooling system	Smoke	Airbus A319	Frontier Airlines
The electronic centralized aircraft monitor (ECAM) indicated a no. 2 pack overheat during the climb through 11,000 ft on departure. A flight attendant reported smoke in the aft cabin, along with an odor that was notable but dissipating. The crew declared an emergency and turned back. During the landing rollout, the ECAM message reappeared, and the crew completed the indicated actions.						
Aug. 23	Cruise	—	Air distribution system	Smoke	Boeing 737	Southwest Airlines
Smoke was detected in the passenger cabin and the aircraft was returned to the departure airport. Maintenance technicians removed and replaced the recirculation high efficiency particulate air (HEPA) filter.						
Aug. 25	Cruise	—	Air distribution system	Smoke	Embraer EMB-145LR	Atlantic Southeast Airlines
The crew reported an electrical smoke odor in flight. Maintenance inspected the aircraft and found the left avionics exhaust fan inoperative, with no other defects detected after ground runs.						
Sept. 3	Climb	Philadelphia (PHL)	Air distribution fan	Smoke, warning indication	Boeing 757	US Airways
Fumes were detected in the cockpit as the aircraft was climbing through approximately 9,000 ft after takeoff. Five minutes later, the crew received an emergency engine-indicating and crew-alerting system (EICAS) message. The crew donned their oxygen masks and declared an emergency. The flight was returned to PHL and landed without further incident. Maintenance technicians replaced the equipment cooling fan.						
Sept. 5	Cruise	Santa Cruz, Bolivia (VVI)	Navigation system	Smoke	Boeing 757	American Airlines
The crew reported smoke and odor in the cockpit and a high-altitude switch shorted. The flight was diverted to VVI and was landed without incident. The aircraft was removed from service. Maintenance technicians placarded the high-altitude switch according to the minimum equipment list.						
Sept. 8	Cruise	—	Cabin cooling system	Smoke	Embraer EMB-135KL	American Eagle Airlines
The crew reported a faint but persistent unusual odor in the cockpit and cabin. They declared an emergency and landed the aircraft without incident. The aircraft was removed from service. Maintenance technicians determined the odor in the cockpit and cabin to be rubber lubricant used on the sleeves of the no. 1 dual temperature control valve, which was removed and replaced.						
Sept. 16	Cruise	Amarillo, Texas, U.S. (AMA)	Air traffic control transponder system	Smoke	Boeing 737	American Airlines
During flight, the crew reported smoke in the cockpit. An emergency was declared and the flight diverted to AMA, where it was landed without incident. The aircraft was removed from service. Maintenance technicians opened the air traffic control/traffic-alert and collision avoidance system panel and found a burned connection to the light panel. The panel was replaced.						
Sept. 17	Cruise	—	Air distribution fan	Smoke	Boeing 737	Continental Airlines
The cabin crew reported visible smoke and a strong burning odor in the cabin. The odor spread from the aft galley to the cockpit but dissipated after the crew completed the procedures in the quick reference handbook. Maintenance technicians inspected the aircraft while performing engine runs and found the left recirculation fan circuit breaker popped and could not reset it. The fan was removed and replaced.						
Sept. 21	Cruise	—	Water/waste system wiring	Smoke	Bombardier Canadair CL-600	Charter
While en route, a cabin attendant detected odor and saw smoke coming from the galley area. The captain asked the first officer to verify and help locate the source of the smoke. Once the location was determined, the captain had the cabin attendant pull all circuit breakers to the galley. The captain shut off all galley and cabin power, declared an emergency and landed the aircraft. Maintenance technicians found that the galley hot water heater had shorted, causing smoke. They disconnected the water heater, pulled and collared the hot water heater and galley power circuit breakers, inspected all surrounding wiring and determined that the aircraft was safe for a ferry flight.						

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